

SINDH AGRICULTURAL GROWTH PROJECT



Training Facilitator Guide on Feeds and Feeding

M.N.M. Ibrahim, E. Kang'the, S.A. Khan and J.Githinji

*(Sindhi & Urdu versions of this manual was Translated by:
Deepesh Bhuptani, Barkat Ali, Ubaid Qureshi and Shahzad Iqbal)*

June 2020

better lives through livestock

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ISBN: 978-969-7564-11-8

Citation: M.N.M. Ibrahim, E. Kang'the, S.A. Khan and J.Githinji, 2020. Training Facilitator guide on Feeds and Feeding. pp. 83.

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PREFACE AND ACKNOWLEDGEMENTS

It is well known that dairy production is influenced to a large extent by the efficiency of feeding practices, animal health management, reproduction and breeding management. All these practices have a direct impact on productivity, health status and herd improvement in dairy animals. As such proper dairy management practices is key to sustain productivity and hence the profitability. Under the Sindh Agricultural Growth Project (livestock component) these aspects of dairy cattle and buffalo management were identified as constraints for enhancing milk production. Also, the lack of knowledge of all stakeholders involved in the dairy value chain (DVC) on modern dairy management practices further hindered productivity of dairy animals.

In order to rectify these gaps in knowledge the International Livestock Research Institute (ILRI) was recruited under a consultancy agreement in July 2017 with the mandate to capacity build all stakeholders involved in the DVC. ILRI with its knowledge in executing other livestock projects in Pakistan, designed capacity building and training interventions for various stakeholders at Provincial, District, Field level staff and dairy farmer producer groups. Training materials were prepared by ILRI team from ILRI publications listed at the end of this manual and finalized after several rounds of discussions with Sindh Livestock Department staff, SAGP-L staff and Plan Int - Pakistan staff. Using these training materials (English/Sindhi/Urdu), over the past 3 years ILRI conducted more than 12000 training programs/activities on various aspects of dairy production to provincial staff, district staff (VOs, Para-vets, LA), and to the 153 MPG members and non-members in the 11 project districts.

The final output of these trainings is the publication of three Facilitation training guides; namely **Feeds and Feeding, Animal Health Management and Reproduction and Breeding**. These training manuals are prepared in English, Sindhi and Urdu languages.

We are indebted to Department of Livestock & Fisheries, Government of Sindh and SAGP-L for their continued support provided during planning and execution of workshops. We are grateful to participants of the workshops (DFMs, LLS, Deputy Directors of Districts, ILRI Pakistan staff and Plan Int. staff) for their valuable inputs during discussions in finalizing the Training materials/manuals. We gratefully acknowledge the support provided by Phillip Sambati (Instructional Designer/ILRI Nairobi) for initiating the preparation of the Facilitator Manual template, and Dr. Okeyo Mwai (Senior Scientist, ILRI Nairobi) for conducting the Animal Reproduction and Breeding trainings, and to ILRI Pakistan Training Associates (Drs. Deepesh, Barkat, Ubaid and Shahzad) for assisting in preparing the training materials and also with the translations of these manuals into Sindhi and Urdu.

Finally, World Bank funding through the SAGP-L project for publishing these manuals is gratefully acknowledged.



Prof. Dr. M.N.M. Ibrahim

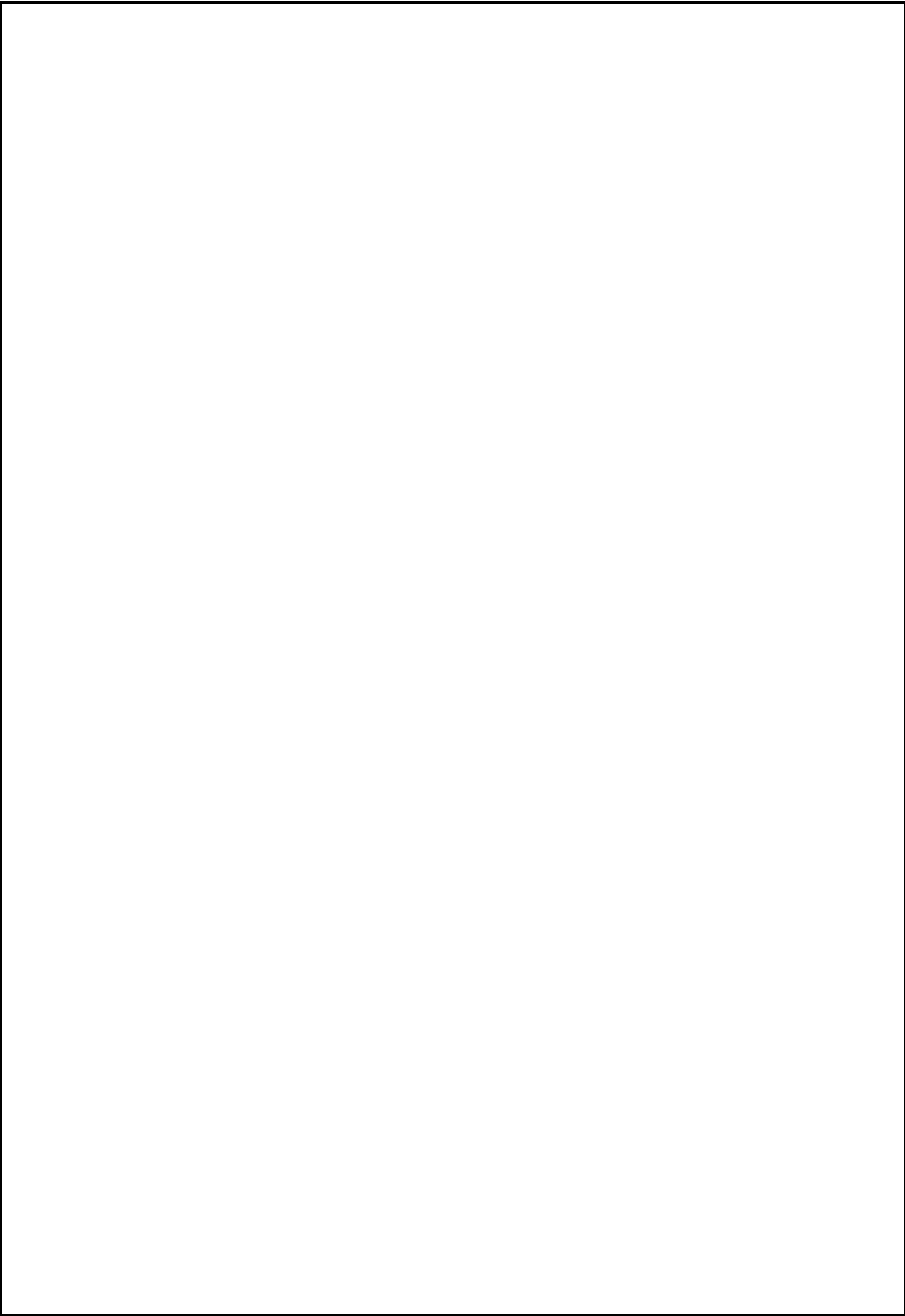
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ABBREVIATIONS

BW	- Body Weight
Ca	- Calcium
CP	- Crude Protein
DCP	- Digestible Crude Protein
DD	- Deputy Director
DFM	- District Field Manager
DM	- Dry Matter
DMI	- Dry Matter Intake
DoL	- Department of Livestock
GoS	- Government of Sindh
ILRI	- International Livestock Research Institute
LA	- Livestock Assistant
LLS	- Lady Livestock Supervisor
ME	- Metabolizable Energy
P	- Phosphorus
SA	- Stock Assistant
SAGP-L	- Sindh Agricultural Growth Project-Livestock Component
TDN	- Total Digestible Nutrients
VO	- Veterinary Officer

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CHAPTER ONE

COURSE INTRODUCTION



CURRICULUM

This course focuses on Feeds and Feeding of dairy animals.

Delivery of this course will take one day with all factors held constant. This includes practical exercises.

The curriculum summary

The following is a summary of sessions and the duration each session will take.

Session	Time taken
Introduction to SAGP-L Training	00h30
Digestive System & Digestion Process	00h45
Energy & Protein Metabolism	00h45
Milk Production	00h45
Basics of Ration Formulation	00h45
Ration Formulation using calculator	00h45
Ration Formulation using Excel spreadsheet	00h45
Ration Formulation using Web-based/Android software	00h45
Feeding Chart Guide for farmers	00h45

SESSION 1. Introduction to SAGP-L Training



00h30

Session Objectives	<p>Introduce the training to the participants including contextualizing the project:</p> <ul style="list-style-type: none">• To ensure that participants are clear how their work embeds with the overall objectives of the program• To ensure workshop objectives are clear• To identify needs and concerns of participants through sharing expectations• To introduce participants to each other• To establish trust and respect through agreeing on ground rules
Session Topics	<ul style="list-style-type: none">• Introductions• Project brief• Training objectives• Setting ground rules
Resources required	<ul style="list-style-type: none">• Flip chart to write ground rules• Sticky notes for participants to suggest ground rules

ACTIVITY I: Introductions and establishing training ground rules

THE NAME GAME & GROUND RULES

- What is your name
- Which one animal do you admire and why
- On a sticky note, suggest two ground rules you'd like all participants to follow in this workshop

ACTIVITY II: Introduce the conversation and scenario approach of this training

OFFICER ISMAIL AND FARMER DAWUD

- Dawud is a small holder dairy farmer who wants to improve his animal's nutrition and health
- Ismail is a government vet who will advise

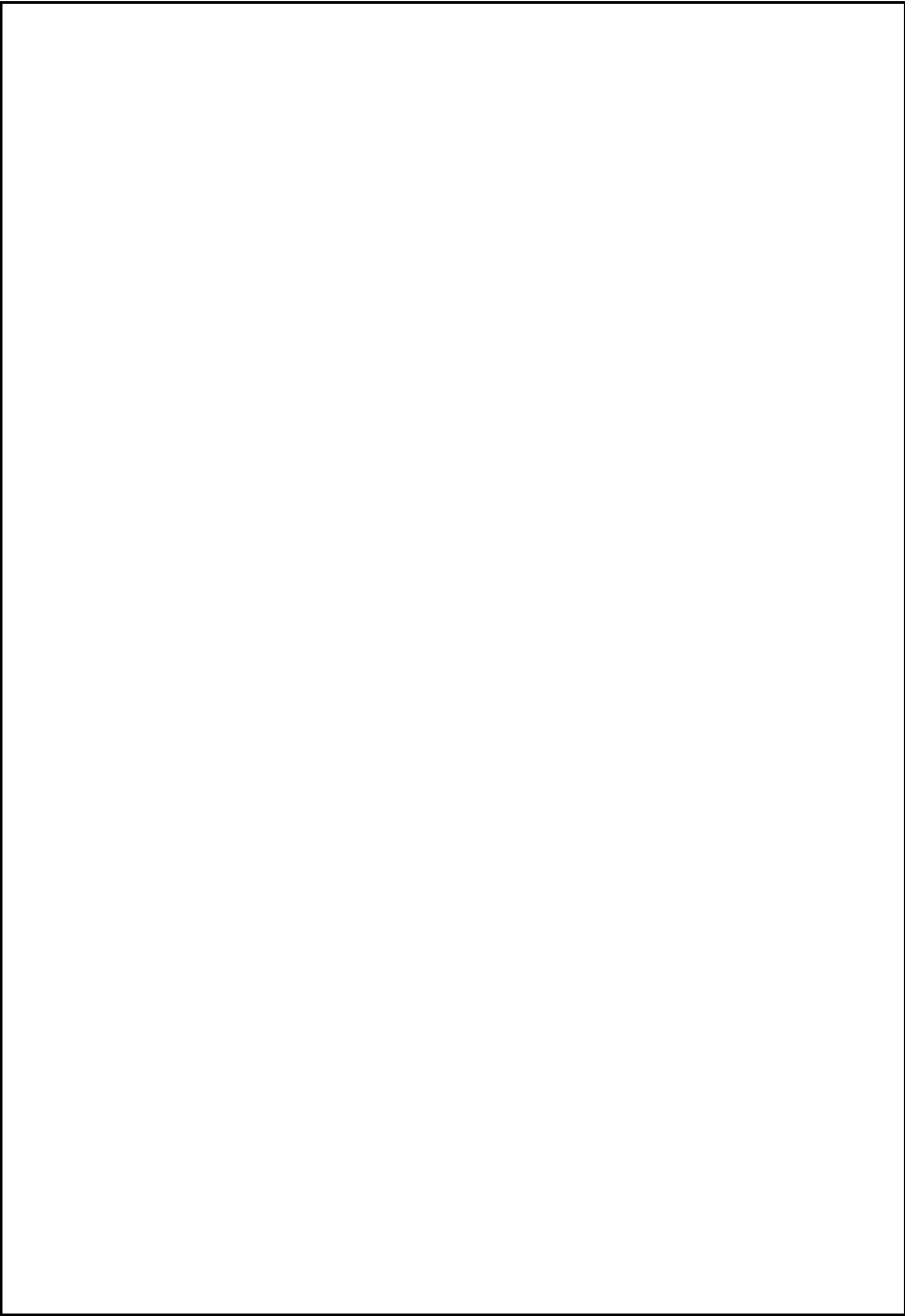


Dawud has been a small holder dairy farmer for years and is interested in improving his production and profits from his small farm



Ismail is a government veterinary officer, he has worked with the community for a long time and understands the difference good animal management can make.

Explain to participants that the training approach will often be in the form of a conversation between a farmer and his extension officer.



CHAPTER TWO

ANIMAL NUTRITION



SESSION 1. Digestive System & Digestion Process



00h45

Session Objectives	By the end of the workshop the participants will be able to: <ul style="list-style-type: none">• Understand the basics of ruminant's digestive cycle and metabolism• List different consideration of ration formulation• Properly use the ration feed formulation tool
Resources required	<ul style="list-style-type: none">• Session handout photos• Dawud and Ismail image flash cards

ACTIVITY I: Introduction and definition of ruminants

RUMINANTS DIGESTIVE SYSTEM

- How do ruminants digest their food?
- What are the basics of their digestive cycle?



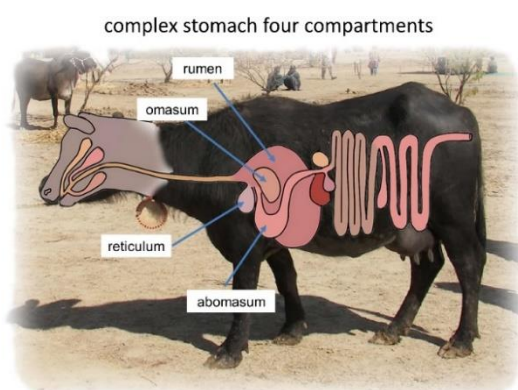
Information on ruminants

- Cattle belongs to the group of animals referred to as ruminants
- Their digestive system is well adapted to herbage-based diet
- These animals have complex stomach comprising of four compartments
- It enables them to utilize various roughages efficiently as compared to non-ruminants
- Compound stomach retains feed and facilitates microbial fermentation Cattle belongs to the group of animals referred to as ruminants
- Small intestines aids digestion of carbohydrates, proteins, lipids, absorption of water, minerals and products of digestion - glucose, amino acids and fatty acids
- Large intestines aids in fermentation of unabsorbed products of digestion by small microbes, aids in absorption of water and facilitates faeces formation



Discussion: Display picture/ animation showing all four compartments of the cow's stomach and discuss in plenary about each stomach's role

Minutes: discussion 30 minutes



KEY MESSAGES



The cow's stomach has the following compartments and the following functions

Rumen

- The rumen (on the left side of the animal) is the largest stomach compartment and consists of several sacs that can hold 25 gallons or more of material depending on the size of the cow
- The rumen is also a fermentation sac, its environment favors the growth of microbes that digest or ferment feed within the rumen and make volatile fatty acids (VFAs). The rumen absorbs most of the VFAs from fermentation
- A good blood supply to the rumen walls improves absorption of VFAs and other digestion products through tiny projections (papillae) that line the rumen, which increases the rumen's surface area and the amount it can absorb

Reticulum

- The reticulum is a pouch-like structure in the forward area of the body, close to the heart. The tissues in the reticulum form a network similar to a honeycomb. A small tissue fold lies between the reticulum and rumen, but the two aren't separate compartments. Together they're called the reticulo-rumen.
- Heavy or dense feed and metal objects eaten by the cow drop into this compartment. Nails and other sharp objects may work into the tissue and cause "hardware disease." You can use magnets to prevent disease or correct the problem through surgery. Leaving it untreated may lead to infection and possibly death.

Omasum

- The omasum is a globe-shaped structure containing leaves of tissue (like pages in a book). It absorbs water and other substances from digestive contents. Feed material (ingesta) between the leaves will be drier than ingesta found in the other compartments.

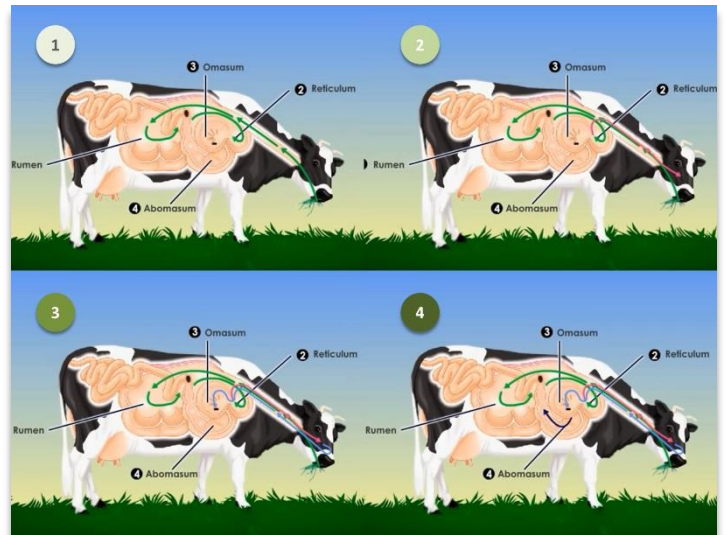
Abomasum

- The abomasum is the only compartment lined with glands. These glands release hydrochloric acid and digestive enzymes, needed to breakdown feeds. The abomasum is similar to a non-ruminant stomach.



Show the 4 steps of the digestion process (refer to image in handout)

- Step 1.** Half chewed grass goes from the mouth to the rumen stomach, here micro-organisms and bacteria breaks it down
- Step 2.** It then enters the second stomach
- Step 3.** From there it is sent back to the mouth to be chewed again, this is where the animal is chewing cud or ruminating
- Step 4.** The re-chewed grass is then swallowed again and goes into the third stomach and passed to the fourth stomach



Do you know why understanding rumination is important to a farmer?



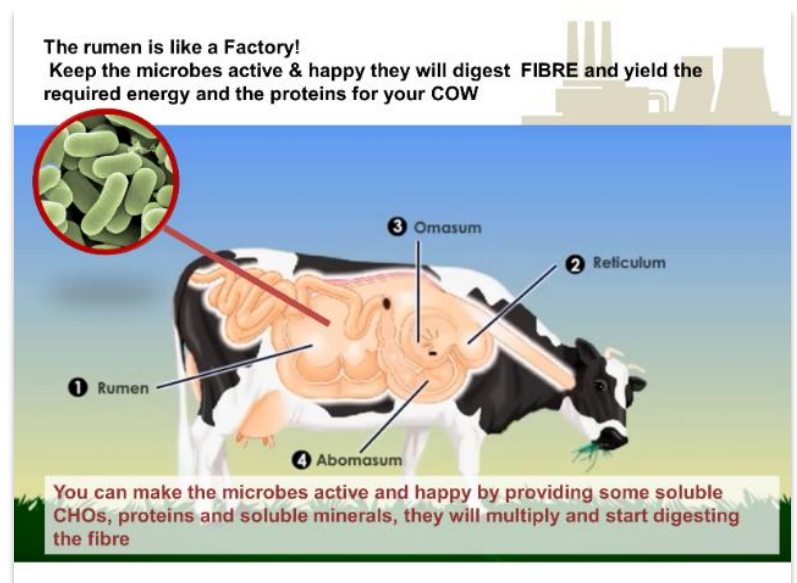
Discussion: In groups of three, discuss why understanding rumination is important to a farmer.

Minutes: discussion 10 minutes, presentation 10 minutes

Each group to present their points in the plenary.

KEY MESSAGES

- Rumination the break down of feed into smaller particles and sizes
- Saliva helps in digestion & maintaining the pH of Rumen
- The amount of Saliva Production depends on type of feed given to the animal (Roughages & Concentrates)



SESSION 2. Energy & Protein Metabolism



00h45

Session Objectives	By the end of the training the participants will be able to: <ul style="list-style-type: none"> Understand and explain the energy needs in cattle Understand the basics of metabolism in cattle List different sources of energy and protein for cattle and buffaloes
Resources required	<ul style="list-style-type: none"> Session handout photos Dawud and Ismail image flash cards

ACTIVITY I: ENERGY AND PROTEIN METABOLISM

UNDERSTANDIGN ENERGY AND PROTEIN METABOLISM IN RUMINANTS

- What is energy metabolism?
- What is protein metabolism?



Information on energy and protein metabolism

- Energy** is the power which comes from the feed the cow eats. A dairy cow uses energy to function. E.g. walk, graze, lactate and maintain pregnancy. Energy is the key requirement for milk production. It determines milk yield, milk composition and body weight.
- Protein** is the building block of the body (i.e. muscles, skin, organs, and foetus). It is required for body function, growth and pregnancy. It is vital for milk production
- Vitamins** are organic compounds that all animals require in small amounts. Both vitamins & **minerals** are necessary for normal function of body and milk production.

(Refer to these images in handout)

Energy & Protein Metabolism

ENERGY:
Energy is the power which comes from the feed the cow eats. A dairy cow uses energy to function. e.g (walk, graze, lactate and maintain pregnancy).




Energy is the key requirement for milk production. It determines milk yield, milk composition and body weight.

PROTEIN:
Building block of body (i.e. muscles, skin, organs, fetus)



It is required for body function, growth and pregnancy. It is vital for milk production



Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

Energy & Protein Metabolism

Calcium=	Strong bones
Vitamin D=	Calcium absorption
Riboflavin=	Energy
Phosphorus=	Strong bones
Protein=	Lean muscle
Potassium=	Fluid balance & blood pressure
Vitamin A=	Good vision & skin health
Vitamin B12=	Red blood cell formation
Niacin=	Energy




VITAMINS & MINERALS:
Vitamins are organic compounds that all animals require in small amounts.

Better Nutrition, Better Health, Better Production



Both vitamins & minerals are necessary normal function of body and milk production.



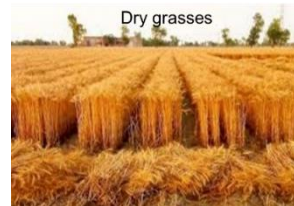
What feeds will provide energy, protein and vitamins to my animal?



The farmer has asked a very good question, let's look at the feeds that can provide these nutrients now

KEY MESSAGES

- Roughages: grasses, forage/fodder (sorghum and maize), legumes (lucerne and berseem), crop residues (wheat and rice straws, maize and sorghum stover)
- Concentrates: concentrate ingredients (cotton seed cake, wheat/rice bran), commercial concentrates (Wanda)



Discussion: In groups of three, discuss local feeds and list them in the three categories of types of feeds

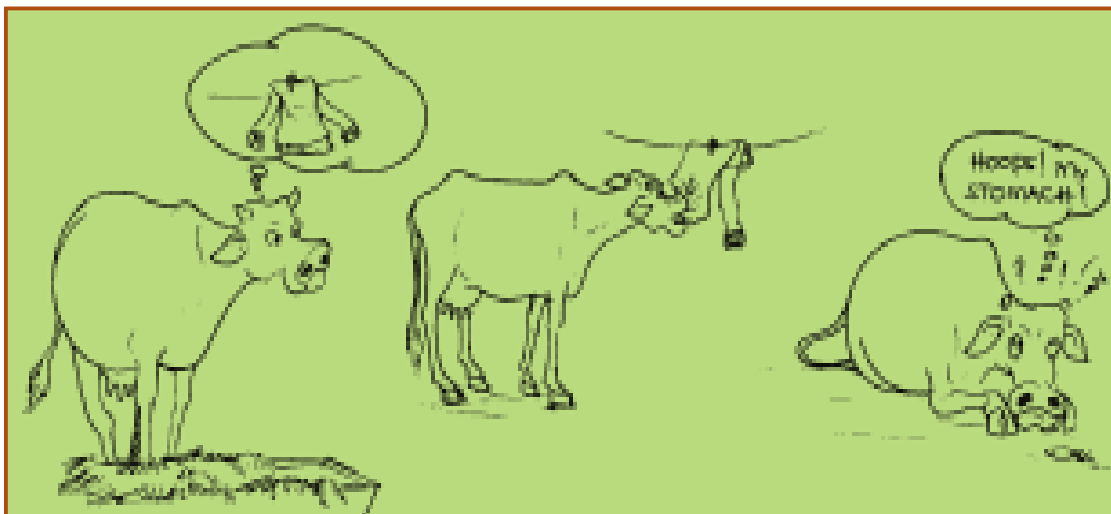
Minutes: discussion 20 minutes, presentation 15 minutes

Each group to write on a flipchart and post on the wall for a gallery presentation.



Discussion: In the plenary, discuss the image below of signs of mineral deficiency in cattle and allow for personal experience sharing by the officers

Minutes: discussion 30 minutes



SESSION 3. Milk Production



00h45

Session Objectives	<p>By the end of the workshop the participants will be able to:</p> <ul style="list-style-type: none"> • Train extension staff and farmer on what measures to take to increase milk production • Train extension staff and farmer on what measures to take to increase milk quality
Resources required	<ul style="list-style-type: none"> • Cow photos of factors related to milk production

ACTIVITY I: FACTORS THAT INFLUENCE MILK PRODUCTION

UNDERSTANDING THE FACTORS THAT INFLUENCE MILK PRODUCTION

What can a farmer do to increase milk production?

What can a veterinary officer do to help a farmer increase milk production?

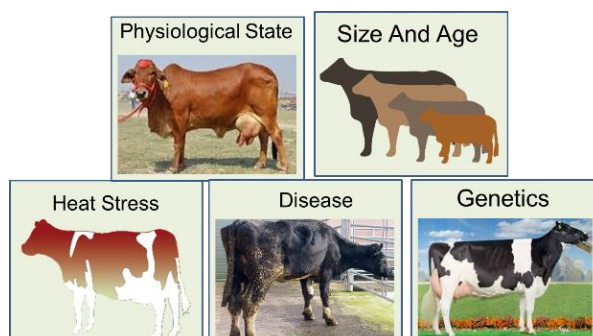


Discussion: In the plenary, ask participants to explain the factors that influence milk production

Minutes: discussion 15 minutes

KEY MESSAGES

- The physiological state of the animal
- Size and age of the animal
- Heat stress
- Disease and infections
- Genetics of the animal



Discussion: Display a poster titled “What entails better health and management in cattle?”

Minutes: discussion 15 minutes

KEY MESSAGES

- TLC
- Well chopped feed
- Clean shed
- Vaccines
- Clean water. An animal requires 60-70 Litre water daily, inadequate water will markedly reduce milk production.



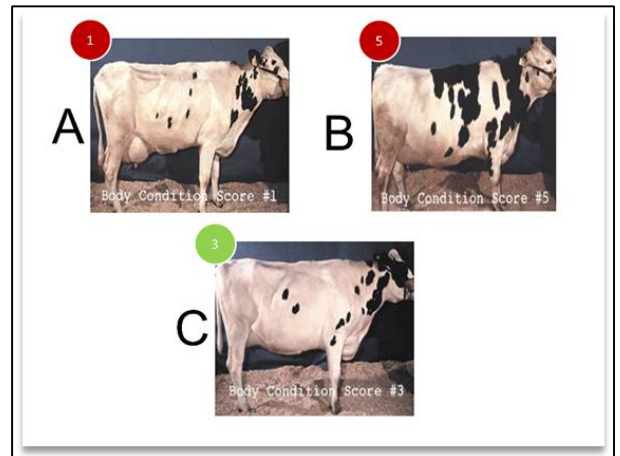


What is the easiest visual way of determining whether my cow will carry a healthy calf and produce more milk?



The farmer has asked a very good question, let's look at the Body Condition Score (BCS) of an animal

- Body Condition Score (BCS) is a reflection of the body fat reserves carried by the animal and is indicated as a scale of 1-5 (1 being too skinny, 3 a good amount and 5 too much)
- **BSC1**- expect problems of cycling and conception after calving
- **BCS3**- good animal for milking
- **BSC5**- expect problems in conception



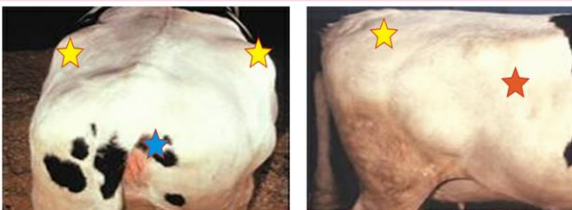
1 BCS of 1 – Too Skinny

'Expect problems of cycling and conception after calving' ❌



5 BCS of 5 – Too Fat

'Expect Problems in Conception' ❌



3

BCS of 3 – Good Animal From Milking Point ✓



CHAPTER THREE

RATION FORMULATION



SESSION 1. Basics of Ration Formulation



00h45

Session Objectives	By the end of the workshop the participants will be able to understand the principles of ration formulation, prepare rations and able to comfortably teach the methodology involved in formulating rations using the software or Feeding chart.
Resources required	Handout (Annex 4: -Handout 1) on ration formulations, Excel and Android software to animal nutritionists/veterinary officers, and field staff as reference during the session. Feed charts to handout to learners for reference during the session

ACTIVITY I: FACTORS AFFECTING FEEDING SYSTEMS



What do I need to know to provide good feeding to my cattle?



This is a very good question; the picture below are the things the extension staff or farmer will need to know to feed the cow well.

Predicting dry matter intake (DMI)

- Gestation- an animal will eat more if given a high-quality diet
- Milk production- an animal will eat medium if given a medium-good quality diet
- Desired weight gain- animal eat less if given low quality forage



How much feed should I feed my cattle and what is the most important feed to provide?



A very good question, the picture below are the things the farmer will need to know to feed the cow well.

Ration formulation depends on:

- Body weight of cow
- Milk yield and fat percentage
- Stage of lactation and pregnancy
- Nutrient requirements of the animal
- Feeds available and their nutritive values

	Desired weight gain	
	Animal requirements:	DM(kg)
	TDN(g)	+
	Milk production	
	Animal requirements:	DM(kg)
	TDN(g)	++
	Gestation	
	Animal requirements:	DM(kg)
	TDN(g)	+++

Ideal cow ration should:

- Provide adequate amount of different, mixed nutrients from variety of sources
- Is palatable and digestible
- Has a good effect on health
- Is bulky and includes plenty of succulent green fodder
- Is economical to feed



If I do not have a animal scale, how to estimate the body weight of my animals ?



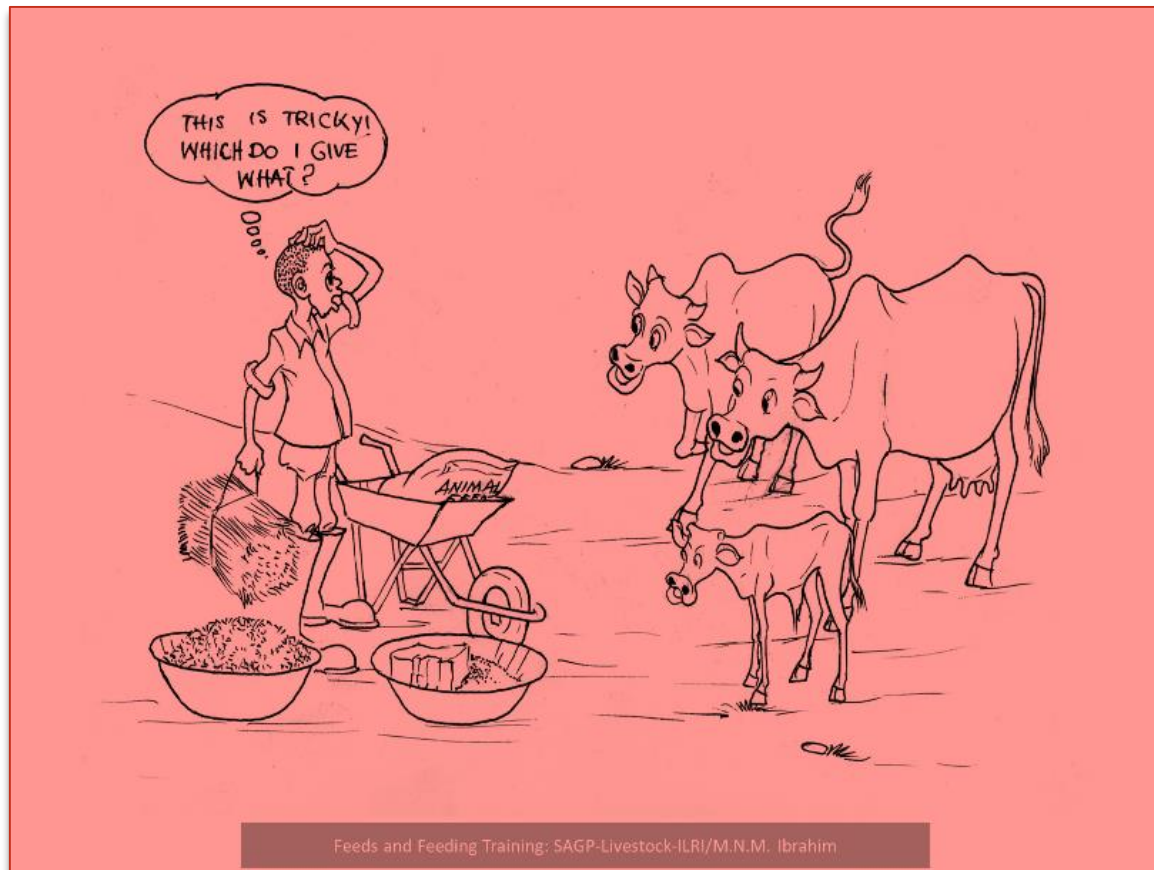
A very good question, you can estimate the body weight by measuring the CHEST GIRTH in centimetres using a cattle tape or any measuring tape and use the chart in the **Annex 4 - Handout 1** to estimate the body weight.





Discussion: In the plenary, show the picture below and ask participants what is the correct answer?

Minutes: discussion 15 minutes



KEY MESSAGES

- The physiological state of the animal
- Size and age of the animal
- Also, remember to feed about 2 tablespoons of salt with the ration

SESSION 2. Ration Formulation using Calculator (for VOs and Nutritionists)



00h45

Session Objectives	By the end of the training the participants will be able to understand the principles of ration formulation, prepare rations and able to comfortably teach the methodology involved in preparing rations using the calculator.
Resources required	Handout on Nutrient requirement tables for cows/buffaloes and Nutritive value of feeds tables for reference during the session (Annex 4: Handout 2)

ACTIVITY I: USING CALCULATOR to FORMULATE RATIONS

Ration Calculations

- ✓ Need to know the Nutrient requirements of cattle and buffaloes!
- ✓ Need to know the Nutrient values of the available feeds!!

- Nutrient requirements of cattle and buffaloes for maintenance, production and reproduction could be obtained from nutrient requirement tables. These tables provide information for varying body weights and production levels, however an in-depth knowledge in nutrition is needed to understand and make proper use of it.
- Field level extension agents need a less cumbersome, simple but reliable quick reference guide to work out the nutrient needs.
- With this aim, composite table which consolidates maintenance, growth, reproduction and pregnancy requirements for differential body weight, milk production and fat content were prepared for both an average **cow (300 kg)** and a **buffalo cow (350 kg)**.



Discussion: Using the Tables below and the **Handout 1 in Annex 4**, discuss the Nutrient Requirements for milk production for a standard milking animal, and using the examples given in the Handout discuss how to adjust the nutrient requirements for different body weights.

Minutes: 15 minutes

Daily nutrient requirements for a growing, pregnant, lactating cow weighing 300 kg (maintenance, growth, gestation and milk production)						
Milk Yield (Litres)	3.0 to 4.0 % Fat		4.1 to 5.0 % Fat		5.1 to 6.0 % Fat	
	TDN (g)	DCP (g)	TDN (g)	DCP (g)	TDN (g)	DCP (g)
1	4190	510	4240	520	4320	530
2	4480	560	4580	570	4740	580
3	4770	600	4920	610	5160	640
4	5060	640	5260	660	5580	690
5	5350	690	5600	710	6000	750
6	5640	730	5940	760	6420	800
7	5930	770	6280	810	6840	860
8	6220	810	6620	850	7260	910
9	6510	860	6960	900	7680	970
10	6800	900	7300	950	8100	1020
12	7380	990	7980	1050	8940	1130
14	7960	1070	8660	1140	9780	1240
16	8540	1160	9340	1240	10620	1350
18	9120	1240	10020	1330	11460	1460

Daily nutrient requirements for a growing, pregnant, buffalo cow weighing 350 kg (maintenance, growth, gestation and milk production)						
Milk Yield (Litres)	4.0 % Fat		6.0 % Fat		8.0 % Fat	
	TDN (g)	DCP (g)	TDN (g)	DCP (g)	TDN (g)	DCP (g)
1	4710	565	4800	580	4900	600
2	5050	625	5230	655	5430	690
3	5390	685	5660	730	5960	780
4	5730	745	6090	805	6490	870
5	6070	805	6520	880	7020	960
6	6410	865	6950	955	7550	1050
7	6750	925	7380	1030	8080	1140
8	7090	985	7810	1105	8610	1230
9	7430	1045	8240	1180	9140	1320
10	7770	1105	8670	1255	9670	1410
12	7380	990	7980	1050	8940	1130
14	7960	1070	8660	1140	9780	1240
16	8540	1160	9340	1240	10620	1350
18	9120	1240	10020	1330	11460	1460

➤ **Adjustment for different body weights:**

For every 50 kg difference in body weight, add or subtract 300 g TDN and 30 g DCP.

Example on the use of Table for cows:

How would you calculate the TDN and DCP requirements for a cow weighing 350 kg and producing 4 litres of milk with 4% fat?

	TDN (g)	DCP (g)
- 300 kg cow producing 4 litres milk with 6% fat	5060	640
- For 50 kg more bodyweight	+ 300	+30
Therefore, you have to feed	<u>5360</u>	<u>670</u>

➤ **In addition:** Buffalo milk contains about 7 - 8 % fat, whereas cattle produce milk with about 3 - 4 % fat. Therefore, they require more TDN for every litre of milk produced.

For EVERY 1% increase in fat content;

👉 **provide for EVERY LITRE** of milk produced

👉 **50 g TDN and 8 g DCP EXTRA**

Example on the use of Table for buffaloes:

A buffalo cow weighing 300 kg and producing 4 litres milk with 7 % fat would require 5990 g TDN and 812 g DCP.

How? See calculation below:

<u>From Table:</u>	<u>TDN</u> (kg)	<u>DCP</u> (kg)
- 350 kg cow producing 4 lit. Milk with 6 % fat	6090	805
- For 50 kg less weight	<u>-300</u>	<u>-25</u>
Therefore you have to feed	5790	780
- For 4 litres milk 7% fat (4x0.005 TDN) & (4x0.008 DCP)	+200	+32
Therefore, you have to feed	<u>5990</u>	<u>812</u>

ACTIVITY II: BALANCING NUTRIENTS

Using a calculator to match requirements and needs



How to match requirements for a given level of milk production?



The example below shows the step-by-step approach to assess the nutrient requirement and the options of combining feeds to obtain the required production (refer to [Annex 4: Handout 2](#))

Examples:

Feeding a 400 kg lactating cow for maintenance, growth, gestation and milk production.

Feeds available and their nutrient composition are given in table below:

Feeds	DM (g)	TDN (g)	DCP (g)	Ca (g)	P (g)
Mott grass	245	146	18	1.7	0.5
Lucerne (alfalfa)	287	195	43	4.0	1.0
Wheat bran	903	750	81	0.7	12.4

Example 1:

How to prepare a ration for the above cow to produce 5 litres milk per day with 4% fat?

Step 1:

Obtain the requirements for the animal from Table 1;

From Table 1:

- 300 kg cow producing 5 l milk with 4 % fat
- For 100 kg more weight (TDN=300x2; DCP 30x2)

TDN (g)	DCP (g)
5350	690
600	60

Therefore, you must feed

5950	750
------	-----

Step 2:

 **Remember forages are cheap, so first check whether you can satisfy the nutrient requirements with forages!!**

✓ First check whether you can satisfy the above requirements using Mott grass alone.

Amount of Mott grass to be fed:

146 g of TDN is present in 1 kg of fresh Mott grass

Therefore, to obtain 5950 g TDN we need = $5950/146 = 40.8$ kg fresh grass

$$\frac{\text{TDN requirement}}{\text{TDN content in feed}} = \frac{5950}{146} = 40.8 \text{ kg}$$

The amount of DCP supplied by feeding 40.8 kg fresh Mott grass is: $40.8 \times 18 = 750$ g which is the DCP requirement of the animal to produce 5 l milk (750 g).

Note:

- The cow's dry matter intake (DMI) capacity is **12 kg DM** ($400 \times 3/100$); The DMI from Mott grass is only **10 kg DM** ($40.8 \times 245 = 9.99$).
- The cow gets sufficient quantity of Ca and P, and Ca:P ratio is close to 2:1.
- Also, remember to feed about 2 table spoons of salt with the ration.

SESSION 3. Ration Formulation using Excel spreadsheet (for VOs and Nutritionists)



00h45

Session Objectives	By the end of the workshop the participants will be able to understand the principles of ration formulation, prepare rations and able to comfortably teach the methodology involved in preparing rations using the software or Feeding chart.
Resources required	Handouts on Excel and Android software to animal nutritionists/veterinary officers, and field staff as reference during the session.

ACTIVITY I: FEEDING GUIDE USING EXCEL SOFTWARE

EXCEL SOFTWARE

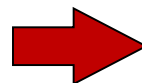
- ✓ What are the benefits of using the Excel program?
- ✓ How can trainers use the program without support?



Discussion: Using **Handout 3 in Annex 4** take the participants through the different data cells in the Ration Formulation Excel sheet allowing for questions in case one is stuck

Minutes: 30 minutes

The spread sheet as it appears when you open it in Microsoft Excel is shown in the adjoining page. Step-by-step instructions are given below in how to enter data!!



Step 1: ENTER the body weight of the cow in kg in cell A2

The following changes will automatically take place:

- Cell A4, will tell you the Dry Matter Intake (DMI) Capacity of your cow;
- Cell E4, F4, G4 and H4 will tell you the TDN, DCP, Calcium and Phosphorus requirement of your cow Maintenance, Growth and Gestation;

Note: The DMI is based on 3% bodyweight of the cow. **However when mature grasses or straw/stover are fed as the main basal roughage, the intake will be lower (25-2.8% bodyweight)**

Step 2: ENTER the Fat content (in %) in your cows' milk in cell A6

Cell E6, will change indicating the amount of TDN needed to produce 1 kg of milk;

Step 3: ENTER the DCP content (in %) in your cows' milk in cell A7

- Cell F6, will change indicating the amount of DCP needed to produce 1 kg of milk;

Note: If you do not know the Protein content, do not make any entry in Cell A7

Step 4: Select the feeds you want to include in your cows ration, you can select up to 20 feeds.

Choose roughages (grass/legume/tree fodders etc) available in the area, 1 or 2 concentrates, and a mineral mixture!!

Step 5: ENTER the name of the feed 1 you want to include in the ration in cell B11, and its DM, TDN,

DCP, Ca and P in cells D10, E10, F10, G10, H10, respectively. These values are in g per kg fresh weight and can be obtained from Table 5 of your Practical Guide for Feeding booklet (extract of 20 common feedstuff nutritive value is given in the Handout). If you know the price of the feed, enter the cost in Rs/kg in cell I 10.

- Depending on the number of feeds you have chosen, continue entering the name of the second feed in B13, and its DM, TDN, DCP, Ca and P in cells D12, E12, F12, G12, H12, respectively, and its price in I 12;

Step 6: ENTER the amount in kg fresh weight you want to include in the ration in cell C11.

The following changes will automatically take place:

- Cells D11 to H11 will change indicating the amounts of nutrients contributed by the said quantity of feed included. Also, I 11 will show the cost of the feed;
- Cell A5 will tell you the amount of Total DM the cow has consumed;
- Cell C3 will tell you the amount of Total Fresh feed the cow has consumed;
- Cells E3, F3, G3 and H3 will tell you the amount of TDN, DCP, Ca and P contributed by the amount of feed to have included;
- Cells E5 to H5 will indicate the amount of nutrients available for milk production;
- Cell E7 and F7 will tell you the amount of milk that can be produced from the nutrients you have supplied via the feed (take the average to assess production);
- Cell G8 will indicate to you the amount of DM the cow can still consume;

	A	B	C	D	E	F	G	H	I
1	Ration calculation Guide (Excel spread sheet prepared by M.N.M. Ibrahim)								
2	A2	Kg weight of cow	kg Fresh Wt.	g Dry Matter	g TDN	g DCP	g Ca	g P	Cost of Ration
3	Total nutrients in this ration		C3		E3	F3	G3	H3	
4	A4	DM intake Capacity (kg)	Maintenance, growth & gestation		E4	F4	G4	H4	
5	A5	Total DMI from Ration (kg)	Nutrients available for milk		E5	F5	G5	H5	I 6
6	A6	Fat content in milk (%)	Nutrients needed for 1 kg milk		E6	F6	2.7	2.0	Cost per kg Milk
7	A7	Protein content in milk (%)	Kg milk from RATION		E7	F7			
8		Cow has eaten	C8 kg DM		She can still eat G8 kg DM				I 8
9	Enter the fresh weight of the feeds you want to include in the cow's ration in the shaded cells below (cell 'C')			DM, TDN, DCP, Ca, P data (all in grams) for pinkish cells you obtain from Table 5 of the Practical guide booklet and enter					
10				D10	E10	F10	G10	H10	I 10
11	1	Feed 1 (B11)	C11	D11	E11	F11	G11	H11	I 11
12				D12	E12	F12	G12	H12	I 12
13	2	Feed 2 (B13)	C13	D13	E13	F13	G13	H13	I 13
14				D14	E14	F14	G14	H14	I 14
15	3	Feed 3 (B15)	C15	D15	E15	F15	G15	H15	I 15



From where can I obtain the DM, TDN, DCP, Ca, P values of Pakistan feedstuffs?



You can get the nutritive values of all commonly available ruminant feeds in Pakistan from the booklet titled “*Practical Guide for Feeding Ruminants in Pakistan*” (Table 5), Published by Prof. M.N.M. Ibrahim. An extract from this book giving nutritive values of commonly available feeds in Pakistan are given in **Annex 4 - Handout 2**.

SESSION 4. Ration Formulation using Web-based and Android software



00h45

Session Objectives	By the end of the session the participants will be able to understand the principles of ration formulation, prepare rations and able to comfortably teach the methodology involved in preparing rations using the web-based and Android software.
Resources required	Handouts (Annex 4: - Handout 4) on software as reference during the session.

ACTIVITY I: FEEDING GUIDE COMPUTER AND ANDROID SOFTWARE








COMPUTER AND ANDROID BASED RATION SOFTWARE

- What are the benefits of using the computer & android based software program?
- How can trainers use the software without support?

When you open the software, the screen below appears.


The screenshot shows the ILRI Ration Formulation Software interface. On the left, a 'Calculate Ration' section contains a dropdown menu (STEP 1), a cow icon (STEP 2), and input fields for 'Body Weight (kg)' (STEP 3) and 'Milk Fat (%)' (STEP 4). Below these are 'Print' (STEP 5) and 'Result' (STEP 6) buttons. On the right, a 'Feed' section displays a grid of 24 feed items, each with a photo and name (STEP 7). The interface also features logos for ILRI, CGIAR, and the World Bank, and a header for 'Prof. Dr. M. N. M. Ibrahim' and 'Sindh Agricultural Growth'.

➤ Use Annex 4: Handout 3 and go through the steps listed below and explain how to select/enter the information requested:

-  **STEP 1:** When you click on the **language** box, drop down menu with the languages will appear, from which you can select the language of your choice (for Pakistan, English, Urdu and Sindhi options are available)
-  **STEP 2:** Click on the **animal** of your choice (Cattle or Buffalo)
-  **STEP 3:** Enter **body weight** of animal in kg
-  **STEP 4:** Enter Fat content in Milk in %
-  **STEP 5:** Select the **Feeds** available to feed the animal, 23 feeds are built into the software; when you select a feed by clicking on the photo, 2 fields opens; (a) the amount of feed in kg fresh weight you want to feed and (b) if you know the price enter in PKR. Then click on the next feed and enter the requested information.
-  **STEP 6:** After adding the information of the feeds, by clicking on **RESULT** information on the feeds you have selected to feed the animal and the amount of milk your animal will produce will be shown in the results sheet.
-  **STEP 7:** Once you are happy with the ration and the desired milk production, then click **PRINT** to get a printout (in pdf format) of the ration and production details.



Do you know why balancing TDN/DCP is important to obtain the desired level of milk production?

 **Discussion:** In groups of 3-4 participants, work out some examples of feeding different grasses and legumes; grasses and concentrate ingredients such as rice bran/wheat bran; grasses and commercial concentrates/UMB; Straws and other forages/concentrates.

Minutes: discussion **15 minutes**, presentation **15 minutes**

SESSION 5. Feeding Chart Guide for Farmers



00h45

Session Objectives	By the end of the workshop the participants will be able to comfortably teach a farmer how to use feed chart
Resources required	Feed charts to handout to learners for reference during the session

ACTIVITY I: FEED CHART

FARMER FEED CHART

What are the benefits of using the feed chart?

How can a farmer use the feed chart without support?

Discussion: take the participants through the feed chart allowing for questions in case one is stuck

Minutes: 45 minutes

Agricultural Innovation Program (AIP) for Pakistan

GUIDE TO USE 'FEED CHART' FOR MILKING CATTLE AND BUFFALOES

Introduction
AIP – Livestock is happy to introduce the 'Guide for Feeding Milking Animals' for use by small scale dairy farmers. Balanced ration is formulated based on level of milk production; 5, 7.5, 10, 12.5 and 15 liters per day for a milking animal of an average weight (Buffalo cow weighing 500 kg; cow weighing 350 kg). Separate guides are available for 'cattle' and 'buffaloes'.

For every 100 kg difference in body weight, add or subtract 3 kg of the roughage

Front

Inside

Back

Step 1: Hold with your left hand

Step 2: Turn **Rotate** until you see the milk production of the buffalo cow or your desired level of production appears in the circle at the Centre of chart

Step 3: After selecting the desired level of milk production, the chart gives you 4 options from which you can select your ration based on green fodder availability and /or type of concentrate available.

Example: for 10 liters' milk

You will see 4 options as given below:

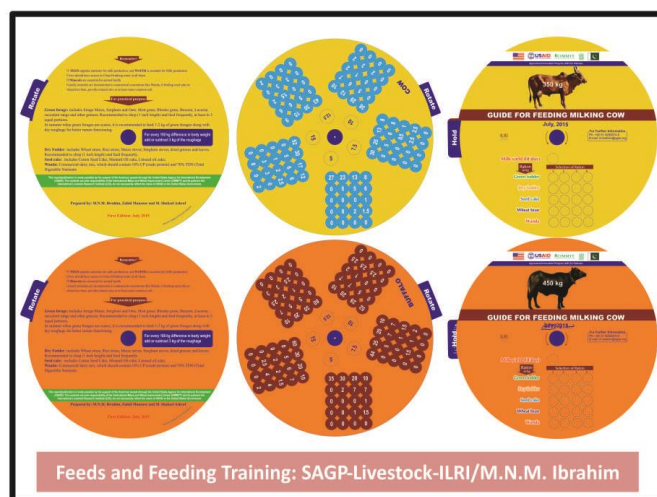
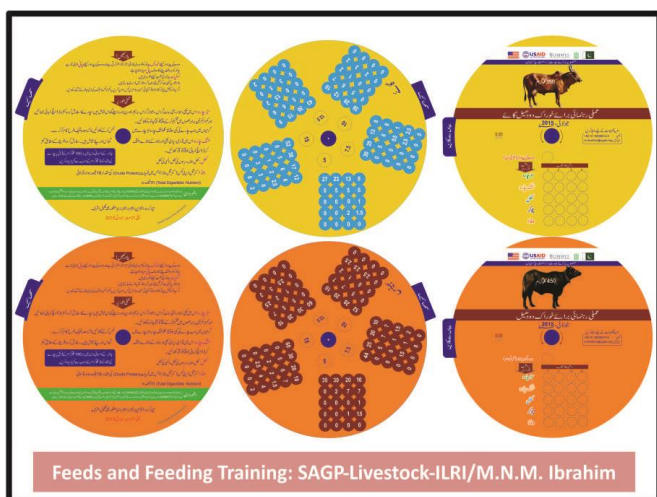
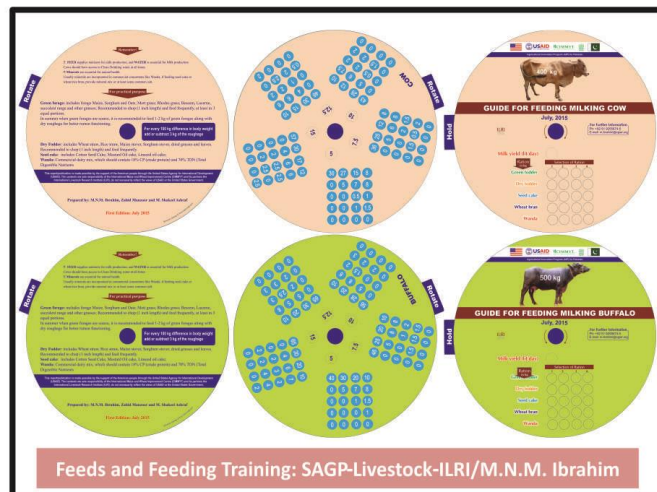
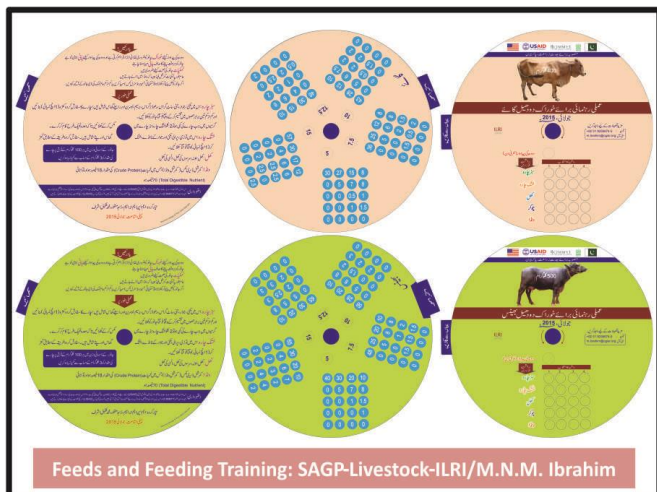
When GREEN fodder availability is HIGH

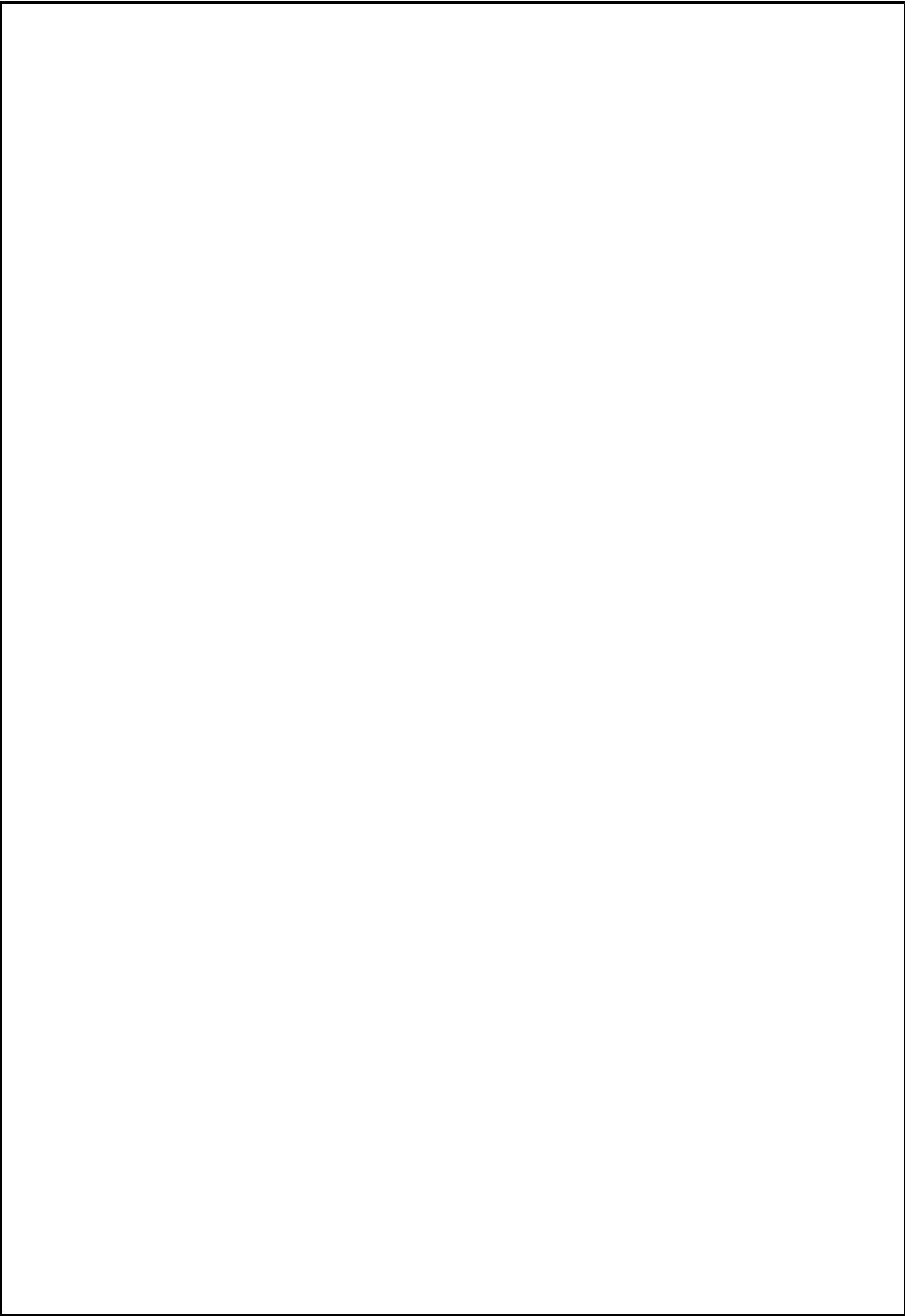
When GREEN fodder availability is MODERATE

When GREEN fodder availability is LOW

When GREEN fodder availability is VERY LOW

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TRAINING MATERIALS

ANNEXES

Annex 1: Power Point Presentation for District Staff

Annex 2: Power Point Presentation for Field Staff

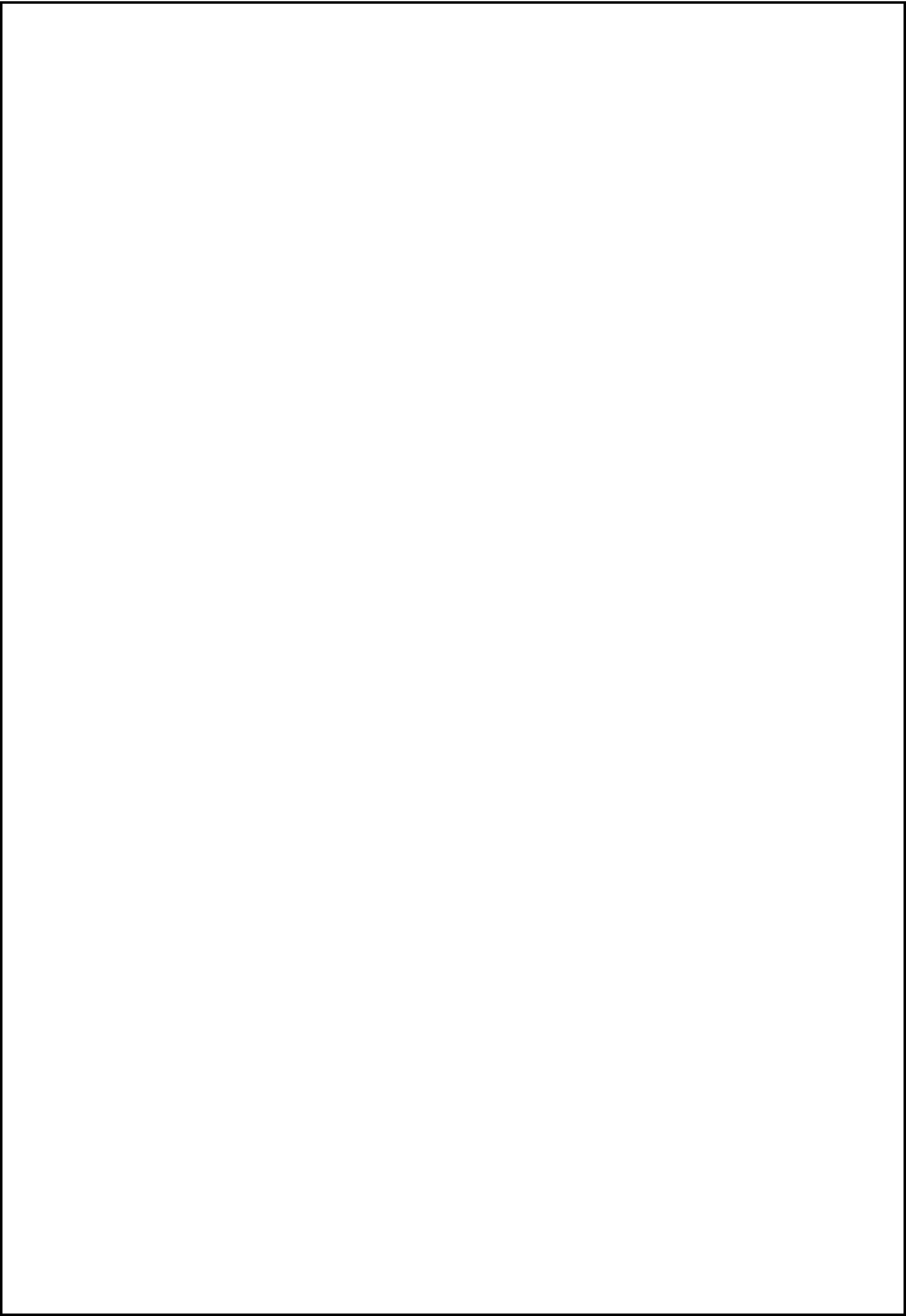
Annex 3: Training Flexes for MPG Farmer Training

Annex 4: - Handout 1: Basics of ration formulation

Handout 2: Feeding to Match Requirements

Handout 3: Using Excel spread sheet to match requirements

Handout 4: Using Computer/ANDROID Software for Ration
Formulation



Annex 1: Power Point Presentation for District Staff

SESSION 1

1

ILRI CGIAR

Sindh Agricultural Growth Project

Feeds & Feeding of Dairy animals

Session 1: Digestive System and Digestion Process

M.N.M. Ibrahim
SAGP-Livestock-ILRI



Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

2

Sections

- Rumen and its functions
- Feeds and its characteristics
- Basic principles of ration formulation
- Feeding and management strategies

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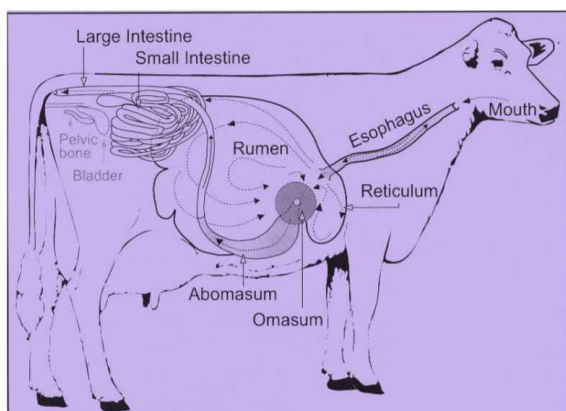
3

Utilization of Various Energy Sources

	Feed	Pigs/Poultry	Cattle/Sheep
Energy			
Sugars	Molasses	+	+
Starch	Roots	+	+
Cellulose	Straws	0	+
Nitrogen			
NPN	Urea	0	+
Protein	Soybean	+	+

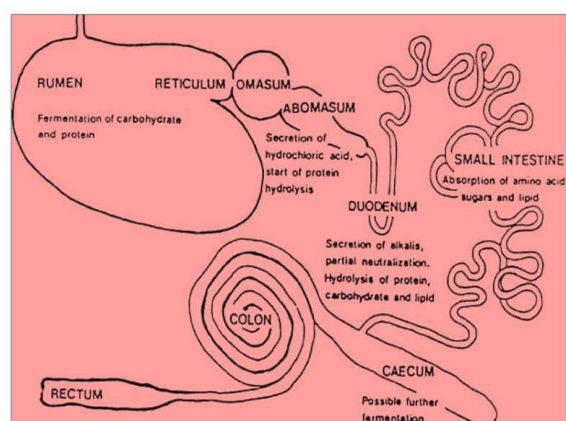
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Rumination (break down of particles) and saliva (buffers) production

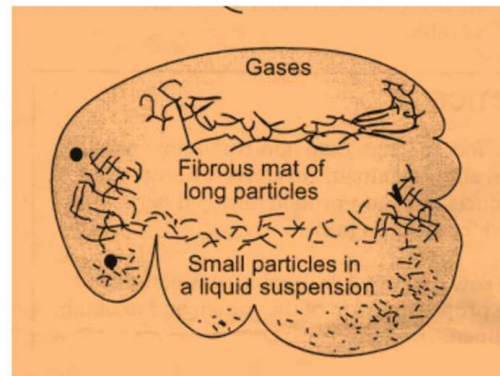
- Rumination reduces particle size of fiber and exposes sugars to microbial fermentation.
- Production of **160 to 180 liters of saliva** when a cow chews 6 to 8 hours per day, but less than 30 to 50 liters if rumination is not stimulated (too much concentrate in the diet).
- Buffers in the saliva (bicarbonate and phosphates) neutralize the acids produced by microbial fermentation to maintain a neutral acidity which favors fiber digestion and microbial growth in the rumen.



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Reticulo-Rumen



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Reticulo-rumen (fermentation)

- Retention of long forage particles that stimulate rumination.
- Microbial fermentation produces: 1) volatile fatty acids (VFA) as end-products of the fermentation of cellulose and other sugars and 2) a microbial mass rich in a high quality protein.
- Absorption of VFA through the rumen wall. The VFA are used as the major energy source for the cow and also for the synthesis of milk fat (triglycerides) and milk sugar (lactose).
- Production and expulsion through belching of as many as 1000 liters of gases per day.

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Omasum and Abomasum

Omasum (recycling of some nutrients)

- Capacity is about 10 litres.
- Function is Absorption of water, sodium, phosphorus and residual VFA.



Abomasum (acid digestion)

- Secretion of strong acids and digestive
- Digestion of feed fractions not fermented the rumen (some proteins and lipids).
- Digestion of bacterial proteins produced in the rumen (0.5 to 2.5 kg per day).



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Small intestine (digestion and absorption)

- Secretion of digestive enzymes by the small intestine, the liver and the pancreas.
- Enzymatic digestion of carbohydrates, proteins and lipids.
- Absorption of some water, minerals and products of digestion: glucose, amino acids and fatty acids.

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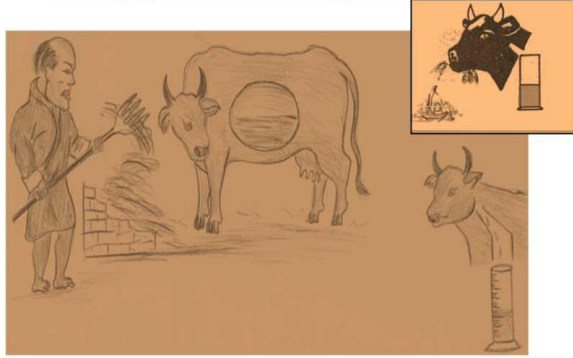
Caecum (fermentation) and large intestine

- A usually small microbial population ferments the unabsorbed products of digestion.
- Absorption of water and feces formation. Gases Fibrous mat of long particles Small particles in a liquid suspension

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Low roughage in diet..... low saliva production!!!!



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More roughage in diet !! More saliva.....!!



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Remember!!

- The rumen is like a Factory!
Keep the microbes active and happy they will digest the FIBRE and yield the required energy and the proteins for your COW
- You can make the microbes active and happy by providing some soluble CHOs, proteins and soluble minerals, they will multiply and start digesting the fibre

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Energy metabolism:

- Fibrous carbohydrates → Increased acetate → increased milk fat and decreased milk yield.
- Non-fibrous carbohydrates → more VFAs → Increased propionate → Increased milk yield (increased glucose synthesis) and decreased milk fat.

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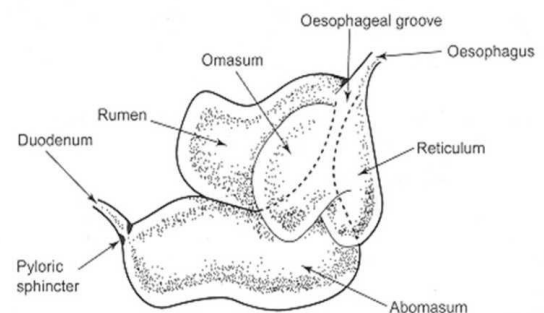
16

Protein Metabolism

- Proteins are largely broken down in the rumen.
- Grain proteins are less soluble and more resistant to microbial degradation in rumen than forage proteins.
- Non-Protein Nitrogen is degraded into ammonia, which is used by bacteria to produce bacterial protein. This process requires easily available carbohydrates (eg. Molasses in Urea-Molasses Blocks).
- Bacterial protein is digested in the intestine.

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SESSION 2

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Sindh Agricultural Growth Project

Feeds & Feeding of Dairy animals

Session 2: Feeds & Feeding Strategies

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SAGP-Livestock-ILRI

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In general, feeds are classified into:

- Forages; (Grasses/legumes/CR)
- Concentrates (energy and protein feeds)
- Minerals and vitamins.

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The general characteristics of forages

Bulky:

- Bulkiness puts limits on how much a cow can eat.
- The energy intake and the milk production of a cow may be limited by too much forage in a ration.
- Bulky feeds are essential to stimulate rumination and maintain the health of the cow.

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The general characteristics of forages

High Fiber and Low Energy:

- Forages may contain from 30 to 90% fiber (neutral detergent fiber).
- In general, the higher the fiber in forage, the lower the energy content of the forage.

Variable in Protein:

- Depending on the stage of maturity, legumes may contain 15 to 23% crude protein;
- grasses typically contain 8 to 18% crude protein (depending on the level of nitrogen fertilization),
- Crop residues may have only 3 to 4% crude protein (straw).

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Concentrates for energy and protein:

- These are feeds that supply more highly concentrated nutrients than forages.
- They contain high levels of protein or energy or both, and also some minerals.
- They are also low in fibre and easy to digest.
- Concentrates are relatively expensive and are therefore fed in relatively small amounts in addition to forages;
- the amounts fed should depend on how much milk the cow is producing.

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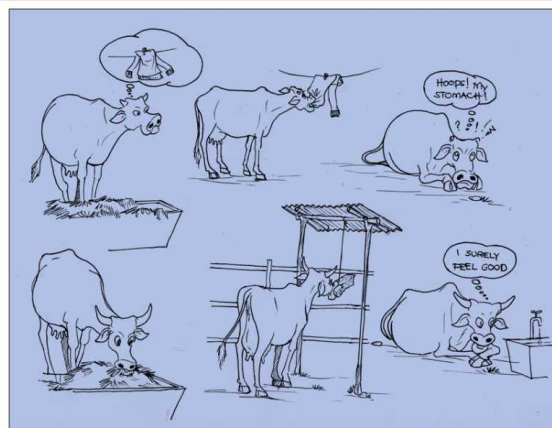
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Mineral supplements:

- some minerals are naturally present in bulk and supplementary forages and concentrates (eg. Rice bran is rich in P, tree legumes have high amounts of Ca and P)
- dairy cows also need to be regularly fed additional minerals.

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Water, essential for life:

- Water is the most important nutrient required.
- It is needed for the process of digestion and absorption.
- A lactating dairy cow needs a lot of water. Her body is 70–75% water, and the milk she produces is over 85% water.
- Ideally, dairy cows should have access to clean drinking water at all times.
- In addition to the amount required for normal bodily functioning, a milking cow requires about five litres of water to produce one litre of milk.
- Inadequate water will markedly reduce milk production.

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Dry matter intake

- is the quantity of moisture-free feed consumed by a cow in a 24-hour period.
- Nutrients in a feed are calculated as a percentage of the ration's dry matter;
- others (such as energy) are calculated as a value per kilogram of dry matter.

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Factors affecting a cow's dry matter intake.

Cow factors

- size and age
- physiological state
- genetics
- disease
- social interaction
- heat stress

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Feed factors

- Digestibility
- Nutrient supply
- Palatability

Physical factors

- ability to harvest pasture
- grazing time
- intake per bite
- access to feed

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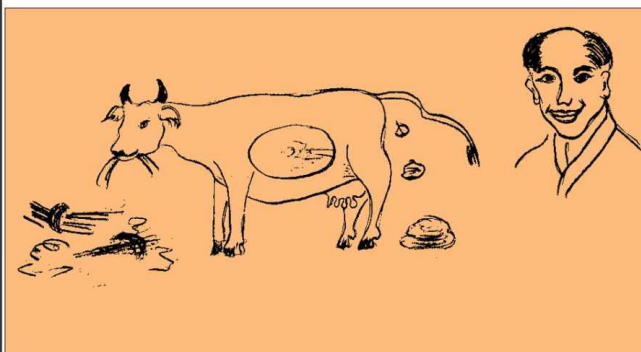
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Shooting diarrhoea



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A simple rule of thumb is





1 kg of GOOD quality concentrate (say 750-800 g TDN) when fed ABOVE maintenance requirements can produce 2.25 litres of milk

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SESSION 3

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Sindh Agricultural Growth Project

Feeds & Feeding of Dairy animals

Session 3: Body Condition Scoring

M.N.M. Ibrahim
SAGP-Livestock-ILRI

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Body Condition Scoring of Dairy Cattle

- Dairy farmers have cattle that are too fat or too thin for their stage of lactation.
- Failure to recognize these cows and take action costs:
 - for disease treatments,
 - lost milk production
 - decreased fertility.
- Body condition is a reflection of the body fat reserves carried by the animal.
- These reserves can be used by the cow in periods when she is unable to eat enough to satisfy her energy needs.
- In high producing cows, this normally happens during early lactation, but it may also happen when cows get sick, are fed poor quality feeds, or feed intake is restricted.

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BCS (contd.....)

- After a period of weight loss, cows should be fed more than their requirements to restore normal body condition.
- Cows should be scored both by looking at and handling the **backbone, loin and rump areas**.
- Since the pin bone, hip bone, the top of the backbone and ends of the short ribs do not have muscle tissue covering them, any covering you see or feel is the combination of skin and fat deposits.
- Condition scores range from 1, a very thin cow with no fat reserves, to 5, a severely over conditioned cow.
- Ideal condition scores fall in the range of 3.0-4.0 at dry off and calving and 2.5-3.5, at peak lactation.

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Score	Condition	Description	
1	Poor	Tail head – deep cavity with no fatty tissue under skin. Skin fairly flexible but coat condition often rough. Loin – spine prominent and horizontal processes sharp.	
2	Moderate	Tail head – shallow cavity but pin bones prominent; some fat under skin. Skin flexible. Loin – horizontal processes can be identified individually with ends rounded.	
3	Good	Tail head – fat cover over whole area and skin smooth but pelvis can be felt. Loin – end of horizontal process can only be felt with pressure; only slight depression in loin.	
4	Fat	Tail head – completely filled and folds and patches of fat evident. Loin – cannot feel processes and will have completely rounded appearance.	
5	Too fat	Tail head – buried in fatty tissue, pelvis impalpable even with firm pressure. The bone structure of the top line, hook and pin bones and the short ribs is not visible.	

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BCS of 1 – Too Skinny 'Expect problems of cycling and conception after calving'



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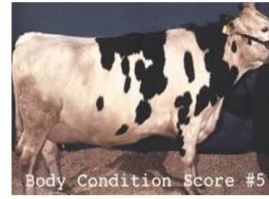
BCS of 3 – At the time of Calving should be between 3 and 4



Body Condition Score #3



BCS of 5 – Too Fat 'Expect Problems in Conception'

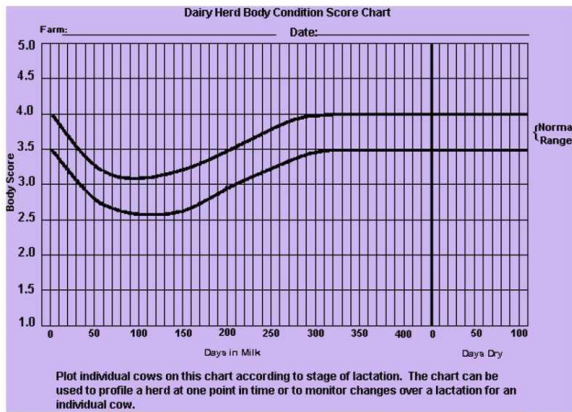


Body Condition Score #5



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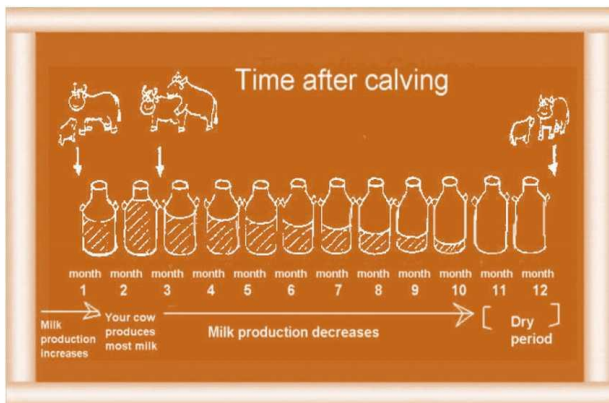
Target BCS scores for stages of lactation

- Cows at calving → 3 to 4
- Early lactation → 2.5 to 3
- Mid-lactation → 3
- Late lactation → 3 to 3+
- Dry → 3 to 4

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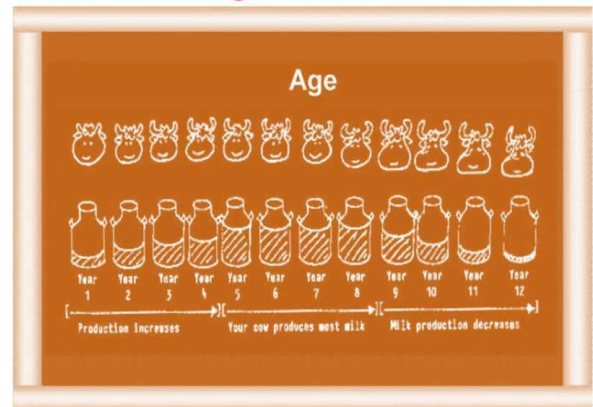
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Lactation Curve



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Effect of Age on Milk Production



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SESSION 4

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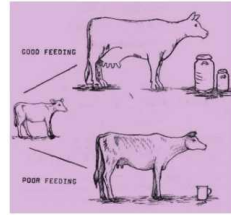
Sindh Agricultural Growth Project

Feeds & Feeding of Dairy animals

Session 4: Ration Formulation

M.N.M. Ibrahim

SAGP-Livestock-ILRI



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Ration Formulation

Step 1 - Obtain Required Information

- Body weight of cow ✓
- Milk yield and fat percentage ✓
- Stage of lactation and pregnancy ≠
- Feeds available and their nutritive values
- Tables of nutrient requirements

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Predicting dry matter intake (DMI)

Rule of thumb No: 1

A lactating cow will eat

- 2.5% of her live weight if given low quality forage,
- 2.8-3% of live weight if given a medium-good quality diet,
- 3.0-3.3% of live weight if given a high quality diet.




Note:

Intakes as high as 4%, 4.5% and 5% of live weight can occur on well balanced rations, especially in European cattle.

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Nutrient Requirements

	Animal Requirements	DM (kg)	TDN (g)	DCP (g)
	Desired weight gain		✓	✓
	Milk production		✓	✓
	Gestation		✓	✓
	Total			

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Daily nutrient requirements for a growing, pregnant lactating cow weighing 300 kg
(maintenance, growth, gestation and milk production)

Milk Yield (Litres)	3.0 to 4.0 % Fat		4.1 to 5.0 % Fat		5.1 to 6.0 % Fat	
	TDN (g)	DCP (g)	TDN (g)	DCP (g)	TDN (g)	DCP (g)
1	4190	510	4240	520	4320	530
2	4480	560	4580	570	4740	580
3	4770	600	4920	610	5160	640
4	5060	640	5260	660	5580	690
5	5350	690	5600	710	6000	750
6	5640	730	940	760	6420	800
7	5930	770	6280	810	840	860
8	6220	810	6620	850	7260	910
9	6510	860	6960	900	7680	970
10	6800	900	7300	950	8100	1020
12	7380	990	7980	1050	8940	1130
14	7960	1070	8660	1140	9780	1240
16	8540	1160	9340	1240	10620	1350
18	9120	1240	10020	1330	11460	1460

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For every 50 kg difference in body weight, add or subtract:
300 g TDN and 30 g DCP

Example

How would you calculate the TDN and DCP requirements for a cow weighing 350 kg and producing 4 litres milk with 4 % fat.

From Table:

	TDN (g)	DCP (g)
- 300 kg cow producing 4 lit. Milk with 4 % fat	5060	640
- For 50 kg more weight	300	30
Therefore you have to feed	5360	670

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Examples:

Feeding a 400 kg lactating cow for maintenance, growth, gestation and milk production.

Feeds available and their nutrient composition from Table 5:

Feeds	DM (g)	TDN (g)	DCP (g)	Ca (g)	P (g)
Mott Grass (edible parts)	181	121	14	0.67	0.58
Legume spp	370	212	35	5.55	0.56
Bran	909	609	77	0.73	12.36

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Example 1:

How to prepare a ration a 400 kg cow producing 5 litres milk per day with 4% fat?

Step 1:

Obtain the requirements for the animal from Table 2;

	TDN (g)	DCP (g)
From Table 2: -300 kg cow producing 5 l milk with 4 % fat	5350	690
-For 100 kg more weight (TDN=300x2; DCP 30x2)	600	60
Therefore you have to feed	5950	750

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Step 2:

Remember forages are cheap, so first check whether you can satisfy the nutrient requirements with forages!!

First check whether you can satisfy the above requirements using Napier grass alone.

Amount of Napier grass to be fed:

$$\frac{\text{TDN requirement}}{\text{TDN content in feed}} = \frac{5950}{121} = 49.1 \text{ kg}$$

How much is 49.1 kg Fresh weight on DM basis?

1 kg Fresh weight has 0.181 kg DM

Therefore 49.1 FW has $49.1 \times 0.181 = 8.8$

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- This is 9 kg DM, and is within the animal's intake limit.
- However, the amount of DCP supplied by feeding 49.1 kg fresh Napier is:
 $49.1 \times 14 = 687 \text{ g}$
Which is below the DCP requirement of the animal.

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Step 3:

- The next option is to replace part of the Mott grass with Ficus which is high in DCP.
- Say, we feed 40 kg of Mott which will supply 4840 g TDN and 560 g DCP, and the balance to be covered by feeding legume.

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As shown below the deficit can be supplied by feeding 5.5 kg legume

Feeds	DMI (kg)	FW (kg)	TDN (g)	DCP (g)	Ca (g)	P (g)
Napier	7.2	40.0	4800	560	26.8	23.2
Legume	2.0	5.5	1200	190	30.5	3.1
Total	9.2	45.5	6000	750	57.3	26.3

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Example 2:

How to prepare a ration for the above cow to produce 10 litres milk per day with 4% fat?

Step 1:

Obtain the requirements for the animal from Table 2;

From Table 2:

	TDN (g)	DCP (g)
-300 kg cow producing 10 l milk with 4 % fat	6800	900
-For 100 kg more weight (TDN=300x2; DCP 30x2)	600	60
Therefore you have to feed	7400	960

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Feeds	DMI	FW (kg)	TDN (g)	DCP (g)	Ca (g)	P (g)
Option 1: If farmer has enough Ficus						
Mott grass	7.2	40	4840	560	26.8	23.2
Legume	4.4	12	2540	420	66.6	6.6
Total	11.6		7380	980	93.4	29.8
Option 2: If farmer has limited Ficus, then use bran						
Mott grass	7.2	40	4840	560	26.8	23.2
Legume	2.6	7	1480	250	38.9	3.9
Bran	1.8	2	1220	140	1.5	24.7
Total	11.6		7540	960	67.2	51.8

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In both options the cow gets sufficient quantity of Ca and P, and Ca:P ratio is 3:1 in option 1 and 1.3:1 in option 2, so there should be no problem.

Also, remember to feed about 2 table spoons of salt with the ration.

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Ration Formulation using Excel program (Use Handout in Annex 4 as guide)

1	A	B	C	D	E	F	G	H	I
2	Ration calculation Guide (Ibrahim 2017)								
3	400	Kg weight of cow	kg Fresh Wt.	kg Dry Matter	g TDN	g DCP	g Ca	g P	COST
4		Total nutrients in this ration	14.0	9.9	6285	643	18.5	11.2	Cost of
5	12.0	DM intake Capacity (kg)	Maintenance, growth & gestation		4500	440	16.0	14.0	Ration
6	9.9	Total DMI from Ration (kg)	Nutrients available for milk		1785	203	2.5	2.8	88.0
7	4.0	Fat content in milk (%)	Nutrients needed for 1 kg milk		315	45	2.7	2.0	Cost per
8	4.0	Protein content in milk (%)	Kg milk from RATION		5.7	4.5			kg Milk
9		Cow has eaten	9.9	kg DM	She can still eat	2.13	kg DM		17.28
10	Enter the fresh weight of the feeds you want to include in the cow's ration in the shaded cells below (cell 'C')				DM, TDN, DCP, Ca, P data (all in grams) for pinkish cells you obtain from Table 5 of the Practical guide booklet and enter				

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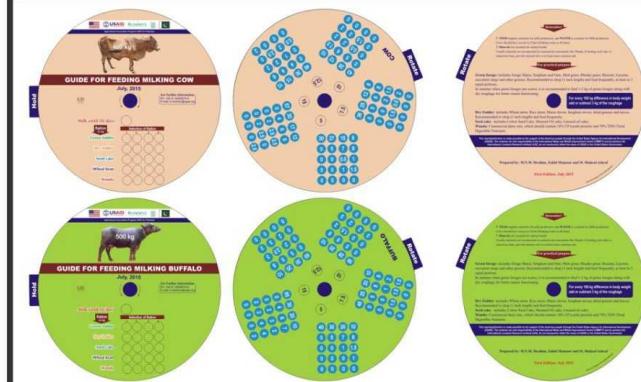
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Ration Formulation Software

(Use Handout in Annex 4 as guide)



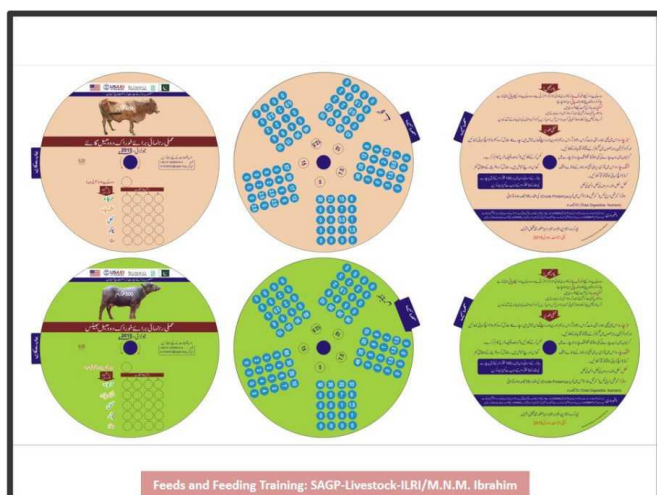
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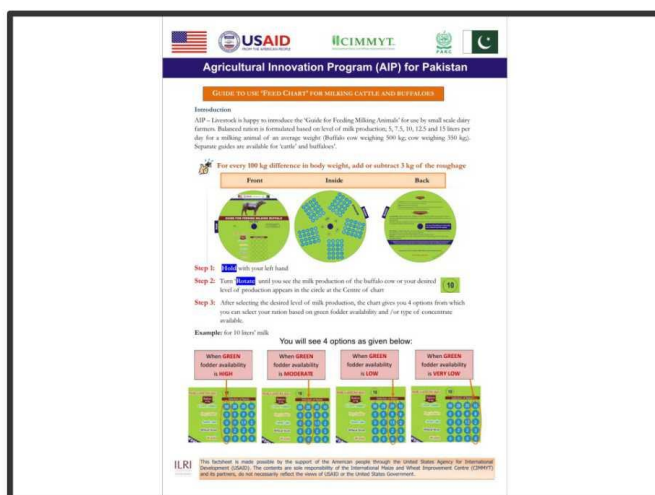
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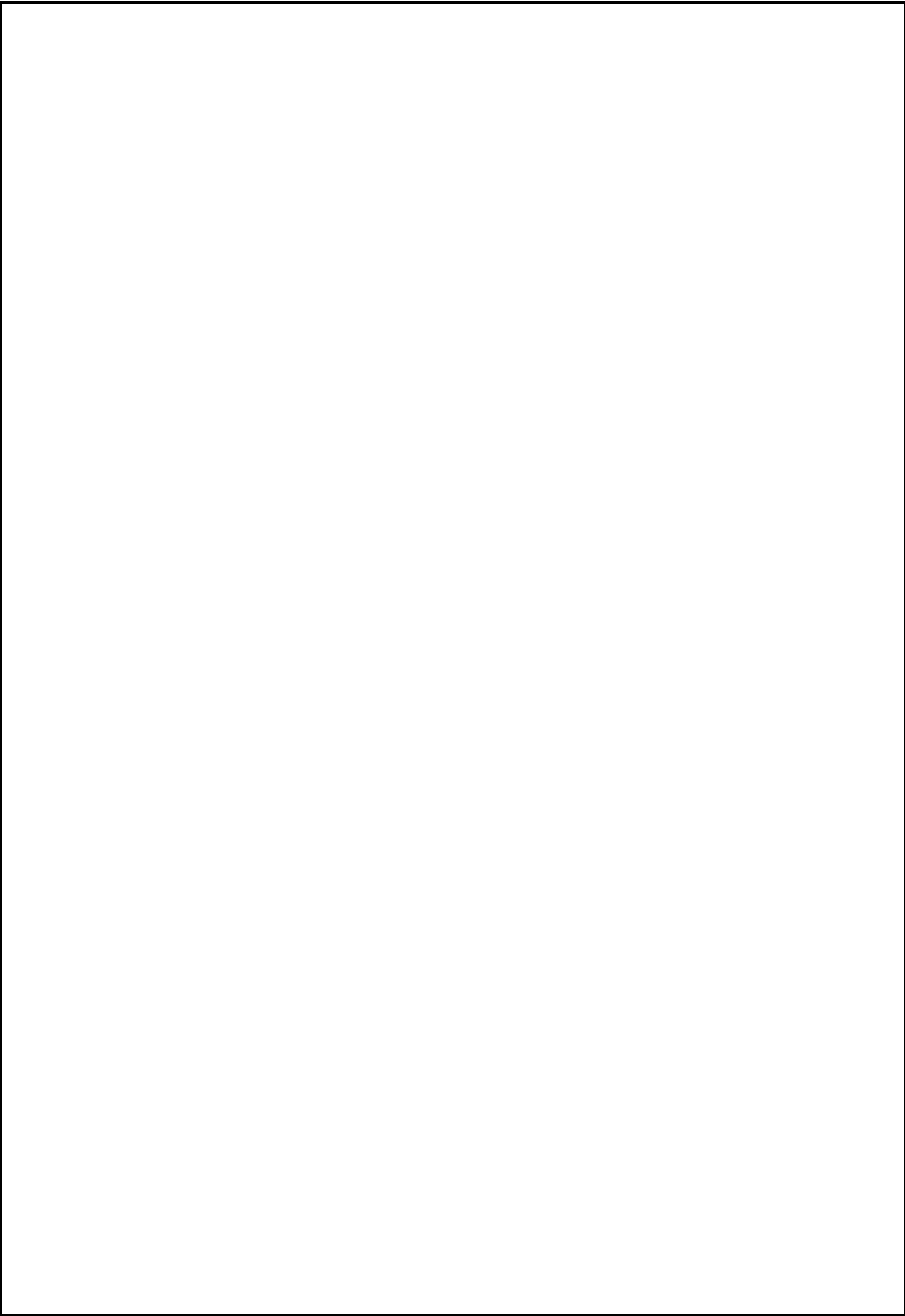


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Annex 2: Power Point Presentation for Field Staff

SESSION 1

1


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Sindh Agricultural Growth Project

Feeds & Feeding of Dairy animals

Session 1: Digestive System and Digestion Process

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2

Sections

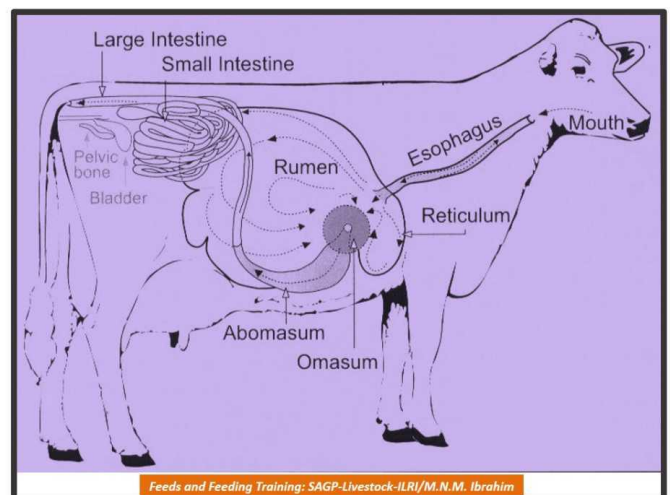
- **Rumen and its functions**
- **Feeds and its characteristics**
- **Basic principles of ration formulation**
- **Feeding and management strategies**

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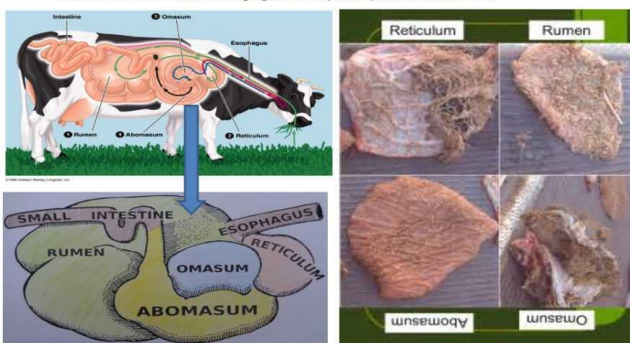


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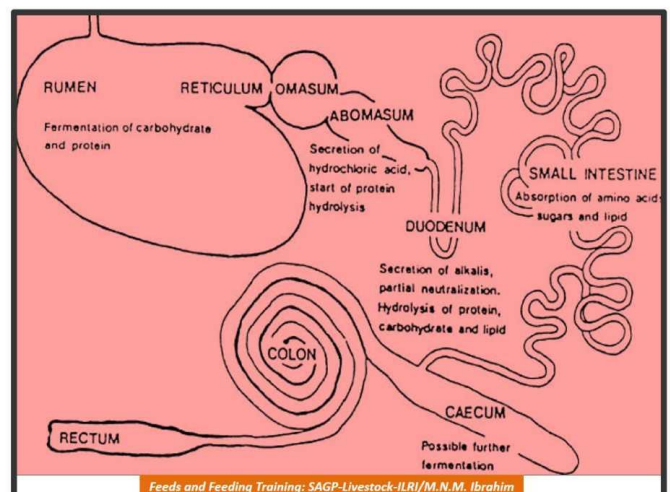
The Digestive System of Ruminants and Feed Composition

- Cattle belongs to the group of animals referred to as ruminants
- Their digestive system is well adapted to herbage based diet
- These animals have complex stomach comprising of four compartments
- It enables them to utilize various roughages efficiently as compared to non-ruminants



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Rumination (break down of particles) & saliva (buffers) production

Rumination: (Rumination mean bringing feed in and out for digestion).

- Breaking down of Feed into smaller Particles / Size



Saliva: (Saliva help in digestion & maintaining the PH of Rumen).

- Amount of Saliva Production: depends on type of Feed.(Roughages & Concentrates)



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(Fermentation & Digestion Process)

COMPOUND STOMACH:

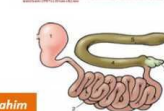
- **Parts:** (Rumen, Reticulum Omesum & Abomasum)
- **Functions:** (Retain Feed & Microbial fermentation)

- **SMALL INTESTINE:** (Digestion and Absorption)

- **Secretion of digestive enzymes:** by the small intestine, (Liver & the pancreas).
- **Enzymatic digestion:** of carbohydrates, proteins & lipids.
- **Absorption:** of some water, minerals & products of digestion: glucose, amino acids and fatty acids.

- **LARGE INTESTINE:** Caecum (fermentation)

- **Fermentation of Unabsorbed Products of Digestion:** (By small microbial)
- **Absorption of water & feces formation.**



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Low roughage in diet..... low saliva production!!!!



More roughage in diet !! More saliva.....!!!



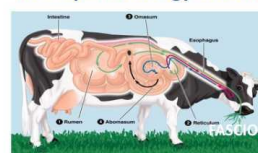
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Remember!!

- The rumen is like a Factory!

Keep the microbes active & happy they will digest FIBRE and yield the required energy and the proteins for your COW



- You can make the microbes active and happy by providing some soluble CHOs, proteins and soluble minerals, they will multiply and start digesting the fibre



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Energy & Protein Metabolism:

ENERGY:

- Energy is the power which comes from the feed the cow eats
- A dairy cow uses energy to function. e.g (walk, graze, lactate and maintain pregnancy)
- Energy is the key requirement for milk production
- It determines milk yield, milk composition and body weight



PROTEIN:

- Building block of body (i.e. muscles, skin, organs, fetus)
- It is required for body function, growth and pregnancy
- It is vital for milk production



VITAMINS & MINERALS:

- Vitamins are organic compounds that all animals require in small amounts.
- Minerals are inorganic compounds
- Both vitamins & minerals are necessary for normal function of body and milk production



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VITAMINS & MINERALS:

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SESSION 2

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Sindh Agricultural Growth Project

Feeds & Feeding of Dairy animals

Session 2: Feeds & Feeding Strategies

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In general, feeds are classified into:

- Forages; (Grasses/legumes/CR)
- Concentrates (energy and protein feeds)
- Minerals and vitamins.

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The general characteristics of forages

Bulky:

- Bulkiness puts limits on how much a cow can eat.
- The energy intake and the milk production of a cow may be limited by too much forage in a ration.
- Bulky feeds are essential to stimulate rumination and maintain the health of the cow.

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The general characteristics of forages

High Fiber and Low Energy:

- Forages may contain from 30 to 90% fiber (neutral detergent fiber).
- In general, the higher the fiber in forage, the lower the energy content of the forage.

Variable in Protein:

- Depending on the stage of maturity, legumes may contain 15 to 23% crude protein;
- grasses typically contain 8 to 18% crude protein (depending on the level of nitrogen fertilization),
- Crop residues may have only 3 to 4% crude protein (straw).

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Concentrates for energy and protein:

- These are feeds that supply more highly concentrated nutrients than forages.
- They contain high levels of protein or energy or both, and also some minerals.
- They are also low in fibre and easy to digest.
- Concentrates are relatively expensive and are therefore fed in relatively small amounts in addition to forages;
- the amounts fed should depend on how much milk the cow is producing.

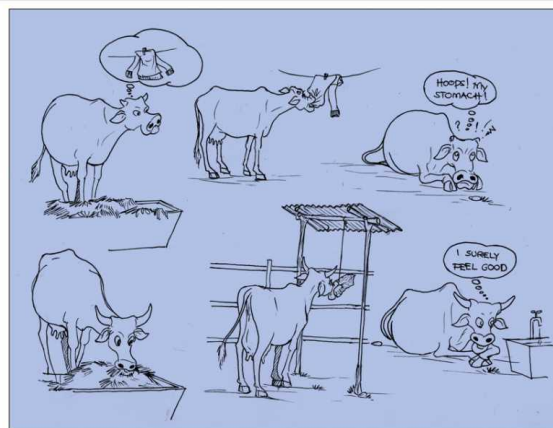
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Mineral supplements:

- some minerals are naturally present in bulk and supplementary forages and concentrates (eg. Rice bran is rich in P, tree legumes have high amounts of Ca and P)
- dairy cows also need to be regularly fed additional minerals.

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Water, essential for life:

- Water is the most important nutrient required.
- It is needed for the process of digestion and absorption.
- A lactating dairy cow needs a lot of water. Her body is 70–75% water, and the milk she produces is over 85% water.
- Ideally, dairy cows should have access to clean drinking water at all times.
- In addition to the amount required for normal bodily functioning, a milking cow requires about five litres of water to produce one litre of milk.
- Inadequate water will markedly reduce milk production.

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Dry matter intake

- is the quantity of moisture-free feed consumed by a cow in a 24-hour period.
- Nutrients in a feed are calculated as a percentage of the ration's dry matter;
- others (such as energy) are calculated as a value per kilogram of dry matter.

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Factors affecting a cow's dry matter intake.

Cow factors

- size and age
- physiological state
- genetics
- disease
- social interaction
- heat stress

Feed factors

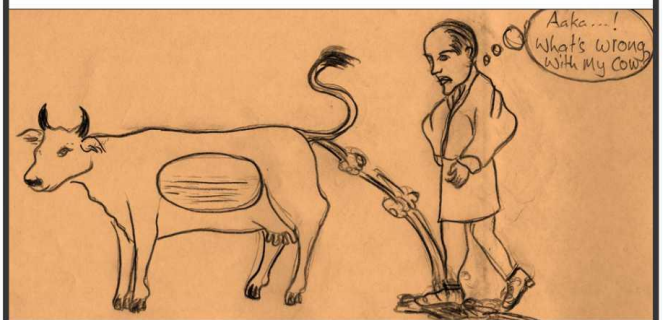
- Digestibility
- Nutrient supply
- Palatability

Physical factors

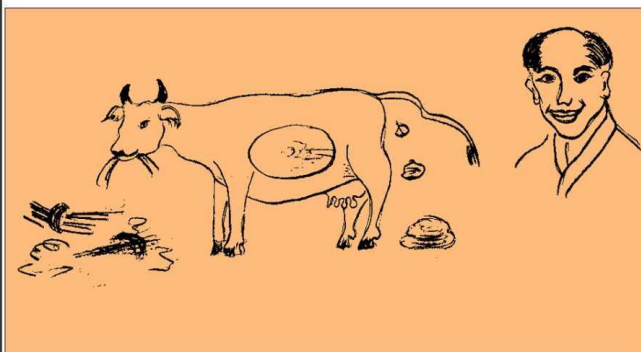
- ability to harvest pasture
- grazing time
- intake per bite
- access to feed

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Shooting diarrhoea



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A simple rule of thumb is

1 kg of GOOD quality concentrate (say 750-800 g TDN) when fed ABOVE maintenance requirements can produce 2.25 litres of milk


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SESSION 3

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Sindh Agricultural Growth Project
Feeds & Feeding of Dairy animals
Session 3: Body Condition Scoring
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Key Points:

- **Feed Characteristics**
- **Water Requirement of Cow/Buffalo**
- **Body Scoring Condition**

In general, feeds are classified into:

- **Roughages ;**
 - Grasses (Natural/Improved)
 - Forage/fodder sorghum, maize
 - Legumes (Lucerne, berseem)
 - Crop residues: Straw (Wheat, Rice); Stover (Maize, sorghum)
- **Concentrates;**
 - Concentrate ingredients: Cotton seed cake; Wheat/Rice bran,
 - Commercial Concentrates: ICI Wanda, Anmol Wanda, DDF Wanda
- **Minerals and vitamins: Calcium, Phosphorus,**

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Concentrates for energy and protein:

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- Dairy cows also need to be regularly fed additional minerals.

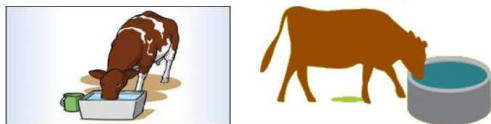


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Water, essential for life:

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- Ideally, dairy cows should have access to clean drinking water at all times.
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- Inadequate water will markedly reduce milk production.



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Body Condition Score (BCS)

BCS is a reflection of the body fat reserves carried by the animal



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Score	Condition	Description	
1	Poor	Tail head – deep cavity with no fatty tissue under skin. Skin fairly flexible but coat condition often rough. Loin – spine prominent and horizontal processes sharp.	
2	Moderate	Tail head – shallow cavity but pin bones prominent; some fat under skin. Skin flexible. Loin – horizontal processes can be identified individually with ends rounded.	
3	Good	Tail head – fat cover over whole area and skin smooth but pelvis can be felt. Loin – end of horizontal process can only be felt with pressure; only slight depression in loin.	
4	Fat	Tail head – completely filled and folds and patches of fat evident. Loin – cannot feel processes and will have completely rounded appearance.	
5	Too fat	Tail head – buried in fatty tissue, pelvis impalpable even with firm pressure. The bone structure of the top line, hook and pin bones and the short ribs is not visible.	

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BCS of 1 – Too Skinny 'Expect problems of cycling and conception after calving'



40

BCS of 5 – Too Fat 'Expect Problems in Conception'



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Target BCS scores for stages of lactation

- Cows at calving → 3 to 4
- Early lactation → 2.5 to 3
- Mid-lactation → 3
- Late lactation → 3 to 3+
- Dry → 3 to 4

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SESSION 4

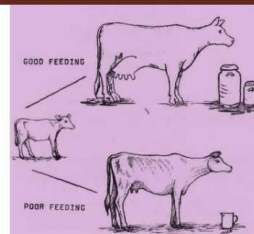
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Feeds & Feeding of Dairy animals

Session 4: Ration Formulation

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Ration Formulation

Step 1 - Obtain Required Information

- Body weight of cow ✓
- Milk yield and fat percentage ✓
- Stage of lactation and pregnancy ≠
- Tables of nutrient requirements
- Feeds available and their nutritive values

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Nutrient Requirements

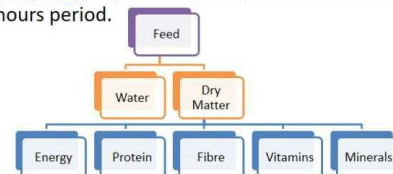
	Animal Requirements	DM (kg)	TDN (g)	DCP (g)
	Desired weight gain		✓	✓
	Milk production		✓	✓
	Gestation		✓	✓
	Total			

Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

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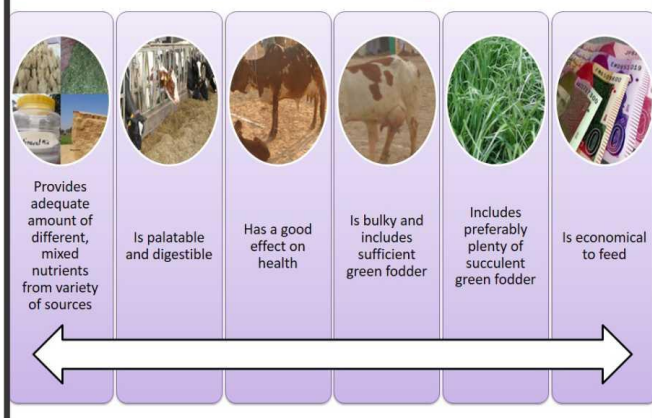
Basic Terminology

- **Total Digestible Nutrients (TDN):** Total energy present in the diet expressed in grams and kilograms.
- **Digestible Crude Protein (DCP):** Amount of the digestible protein present in the diet.
- **Dry Matter Intake (DMI):** Dry matter (feed part with no water) ingested in 24 hours period.



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Qualities of an Ideal Dairy cow Ration



Predicting dry matter intake (DMI)

Rule of thumb No: 1

A lactating cow will eat:

- 2.5% of her live weight if given low quality forage,
- 2.8-3% of live weight if given a medium-good quality diet,
- 3.0-3.3% of live weight if given a high quality diet.

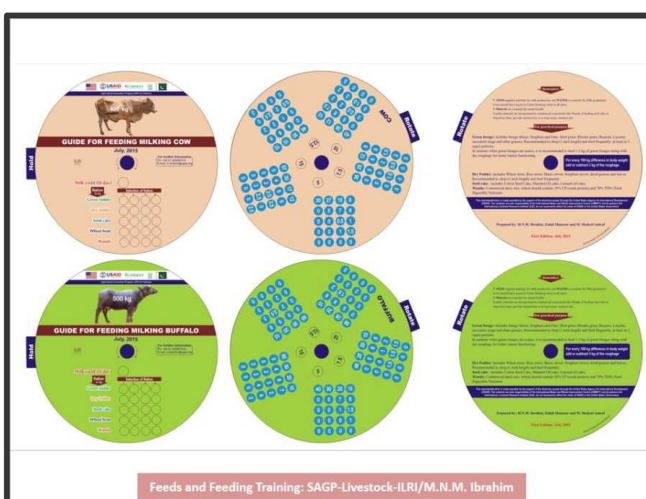


Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

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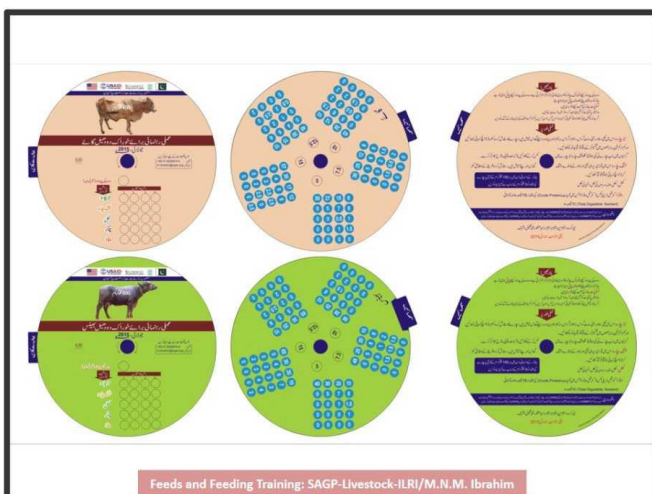
1	A	B	C	D	E	F	G	H	I
2									
3	400	Kg weight of cow	kg Fresh Wt.	kg Dry Matter	g TDN	g DCP	g Ca	g P	COST
4	Total nutrients in this ration	14.0	9.9	6285	643	18.5	11.2		Cost of
5	12.0	DM intake Capacity (kg)	Maintenance, growth & gestation	4500	440	16.0	14.0		Ration
6	9.9	Total DMI from Ration (kg)	Nutrients available for milk	1785	203	2.5	2.8		88.0
7	4.0	Fat content in milk (%)	Nutrients needed for 1 kg milk	315	45	2.7	2.0		Cost per
8	4.0	Protein content in milk (%)	Kg milk from RATION	5.7	4.5				kg Milk
9		Cow has eaten	9.9	kg DM	She can still eat	2.13	kg DM		17.28
10	Enter the fresh weight of the feeds you want to include in the cow's ration in the shaded cells below (cell 'C')		DM, TDN, DCP, Ca, P data (all in grams) for pinkish cells you obtain from Table 5 of the Practical guide booklet and enter						



Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

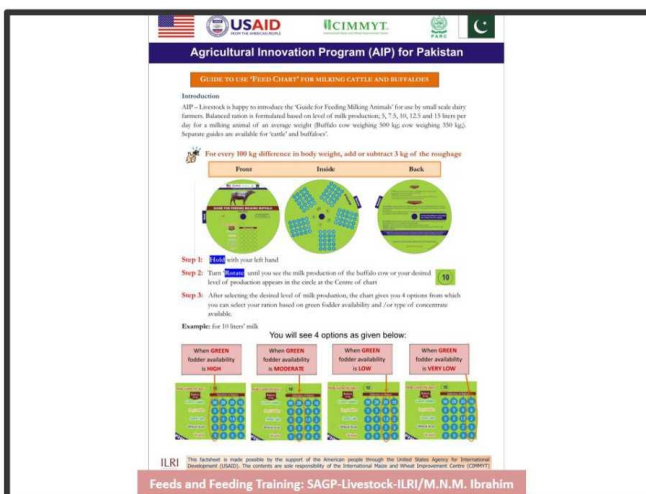
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Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

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Feeds and Feeding Training: SAGP-Livestock-ILRI/M.N.M. Ibrahim

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Annex 3: Training Flexes for MPG member training

Sindh Agricultural Growth Project

FEEDS & FEEDING OF MILKING ANIMALS

Part 1: Digestive System and Digestion Process

Part 2: Feeds & Feeding Strategies

Part 3: Ration Formulation

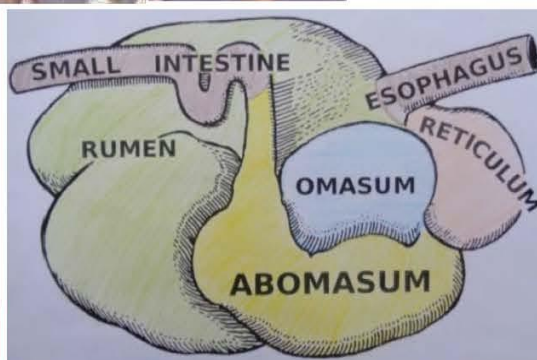
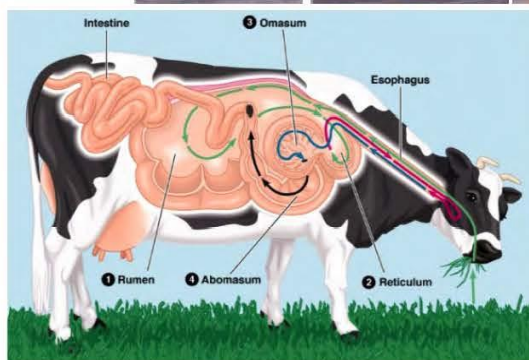
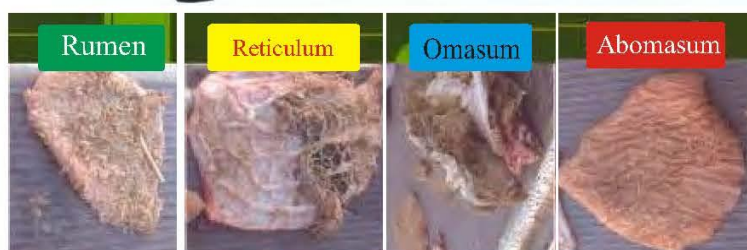
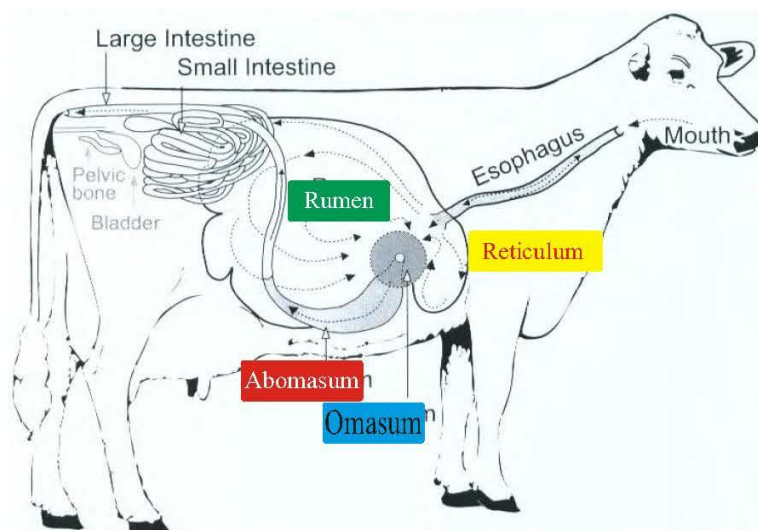


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Digestive System Of Ruminants/Digestion Process

- ▶ Cattle and Buffalo stomach is divide into four parts; those animal come into ruminates group.
- ▶ Digestive system of cattle and buffalo (Digest the fodder efficiently, which depends upon digestible feeds. They have better ability of rumination as compare to that of non ruminants.



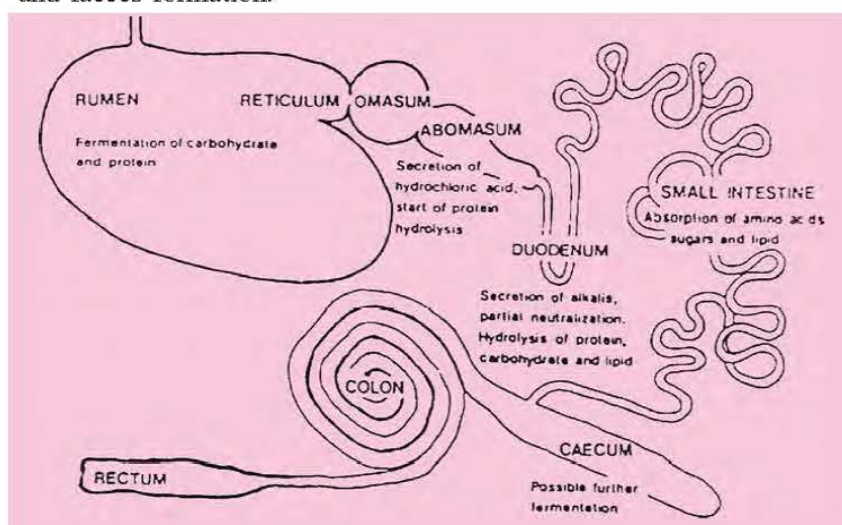
Fermentation Of Feed & Digestion Process

Stomach of Ruminats

Function of Stomach: Storage of feed and breaked down of feed into small particle with the help of microbial organism

Small Intestine: Digestion and absorption of available starch, protein and minerals present in the feed.

Large Intestine: Digestion of remaining indigestible feed with the help of microbes and absorb water and faeces formation.



Rumination (Break Down of Particles) & Saliva (Buffers) Production

Rumination Process:

Breaking down of the feed into small particles

Saliva:

Help in digestion and maintain the pH of rumen.

Quantity Of Saliva Production:

Need of the saliva production depends upon the different types of feeds (Roughages and concentrates)



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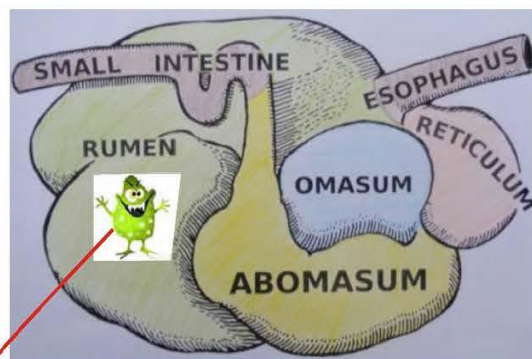
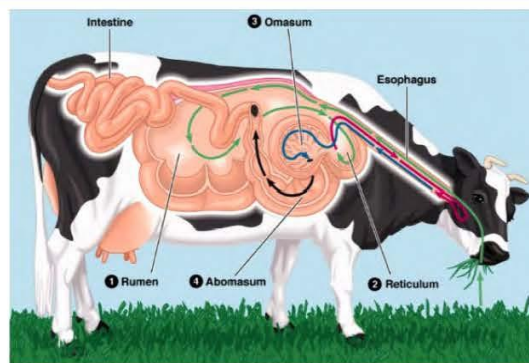
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Remember....

Rumen is a factory

Keep the microbes active and happy they will digest the **FIBRE** and yield the required energy and the proteins for your animal.

You can make the microbes active and happy by providing some **soluble CHO**s, **proteins** and **soluble minerals**, they will multiply and start digesting the fibre.



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Energy, CHO, Minerals & Vitamins

- 1 **Energy:** Milking animal get energy from feed which is required for the different work by cattle and buffalo.

For example: Important role in energy, movement, milking and gestation.



- 2 **Protein:** It is required for different work in animals body.

For example: Important role in body building, growth and milk production, estrus and calving.

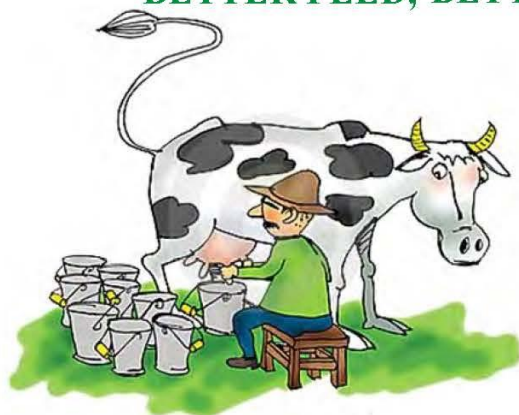


- 3 **Mineral and Vitamin:** Give minerals and vitamins 100 to 200 grams in ration daily. It helps in:

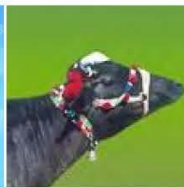
For example: Important role in body building, growth and milk production, estrus and calving.



BETTER FEED, BETTER HEALTH, BETTER PRODUCTION

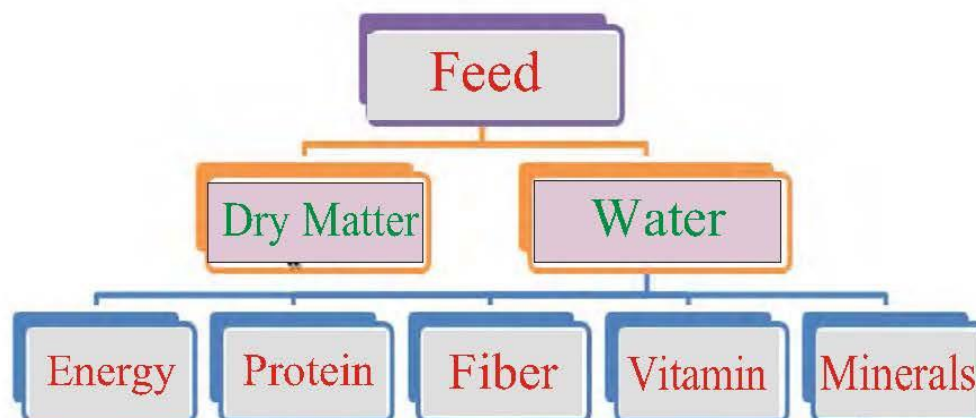


BETTER LIVES THROUGH LIVESTOCK



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Three Types Of Feed:

1. **Forages:** Barley, Berssem, Silage, Wheat straw, Sorghum, Millet and Crop leaves.
2. **Concentrates:** Cotton seed cake, Wheat straw, Rice straw, Wheat grain crush, Concentrate ICI and Concentrate DDF.
3. **Minerals:** Salt, Calcium and Phosphorous.



A. Green fodder,



B. Dry fodder.



C. Wheat straw



D. Leaves of plant

On the daily basis give 100 to 200 grams of minerals.



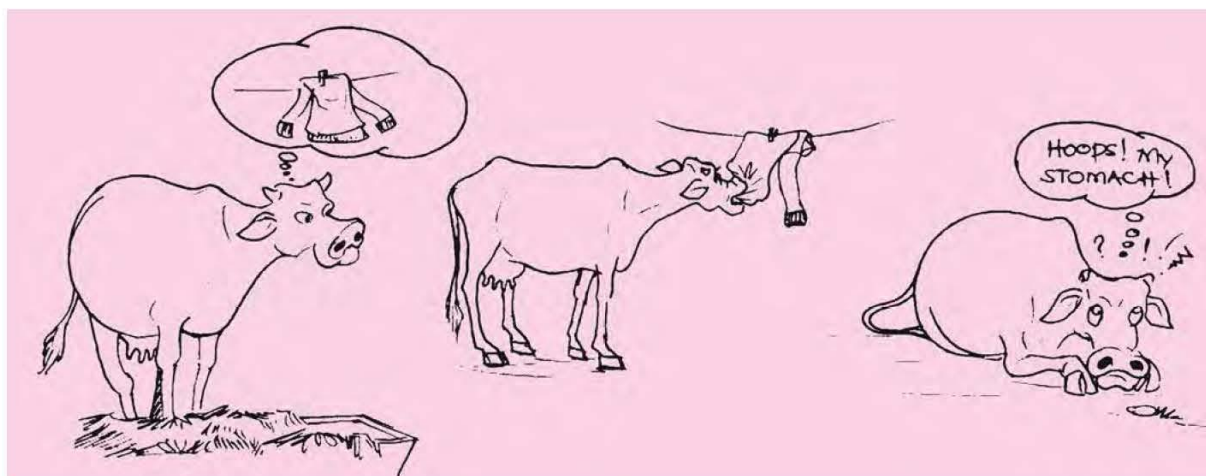
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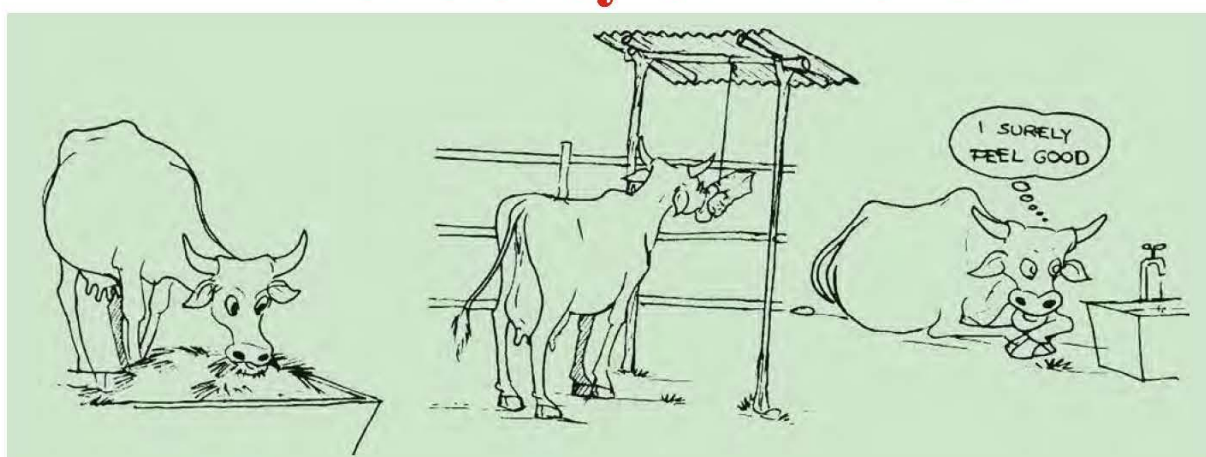
Concentrate Feed/Energy and Protein

These are feeds that supply more highly concentrated nutrients than forages.

Extra minerals & vitamins should be offered to the milking animals on daily basis.



Deficiency of minerals



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Balanced Ration



Fodder Calendar for (Annually Availability of Fodder) / Annual Fodder Calendar

Fodders	Important Nutrients	Total Digestible Energy	Total Digestible Protein	Cultivation Season	Harvesting Season	Crop (Cut)	Preservat ion
		In (gm) on the basis of fresh weight					Methods
Maize	Starch	144	13	January-To-August	April-To-November	Single Cut	Silage
Sorghum	Starch	222	8	March-To-July	October-To-May	Multi Cut	Silage
Rhodes Grass	Starch	519	41	March-To-September	March-To-December	Multi Cut	Hay
Barseem	Protein	75	23	October-To-December	November-To-May	Multi Cut	Half Dry
Lucern	Protein	117	34	November-To-July	October-To-July	Multi Cut	Hay



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Factor Affecting On Dry Matter Intake Of Buffalo/Cattle

Size & Age



Physiological State



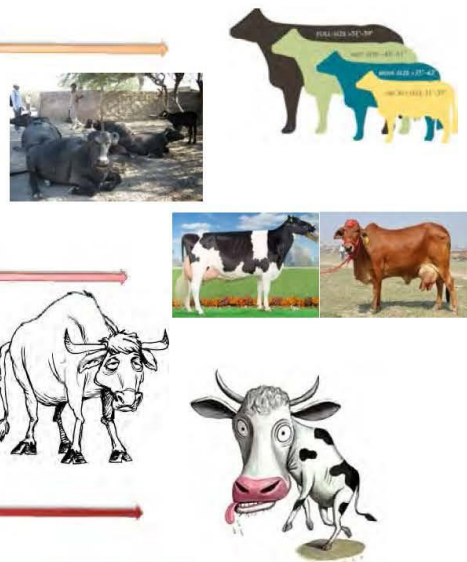
Genetics



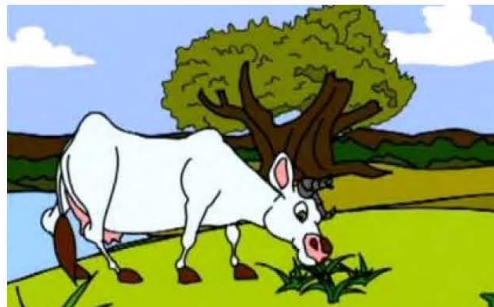
Disease



Heat Stress



Better Health / Better Management



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Importance Of Water

Water is the most important nutrient required.

It is needed for the process of digestion and absorption.

A lactating dairy cow needs a lot of water. Her body is 70–75% water, and the milk she produces is over 85% water.

Ideally, dairy cows should have access to clean drinking water at all times.

In addition to the amount required for normal bodily functioning, a milking cow requires about five litres of water to produce one litre of milk.

Inadequate water will markedly reduce milk production.

Water requirement for animal is 60 to 70 litres of water / per day.



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Body Condition Scoring Of Milking Animals (BCS)

Scoring Of WeAk Animal



Scoring Of Fatty / Too Fatty Animal



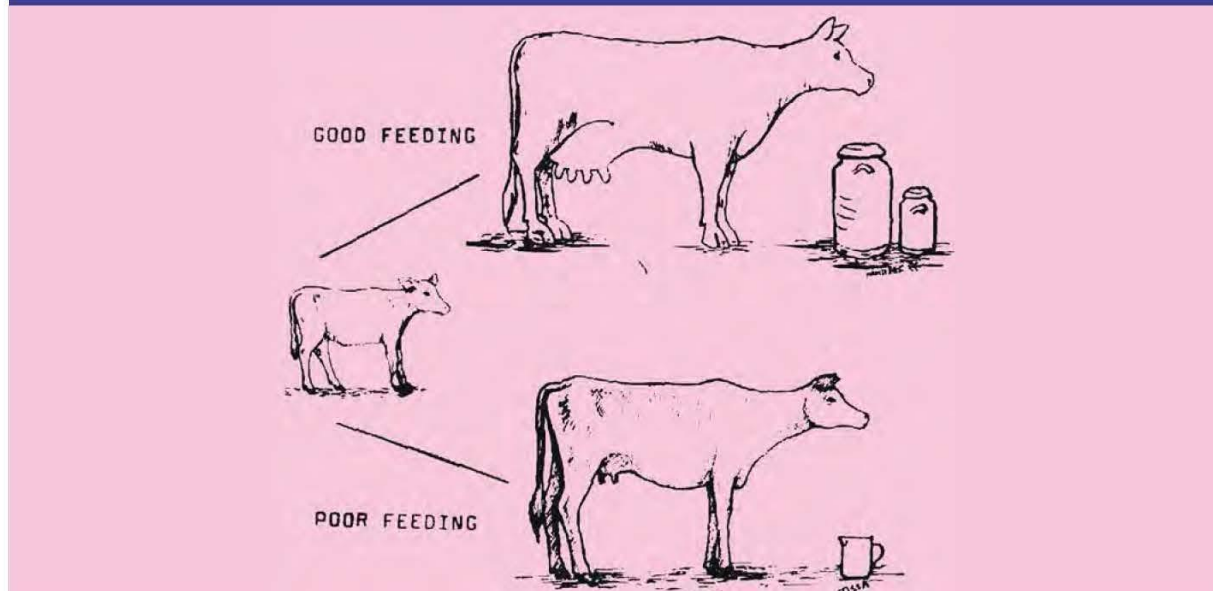
Scoring Of Ideal Animal According To Milk Production






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Requirement Of Balanced Ration



NUTRIENT REQUIREMENT

Animal Requirements		DM(kg)	TDN(g)	DCP(g)
	Desired Weight Gain		+	+
	Milk Production		++	+++
	Gestation		+++	+++



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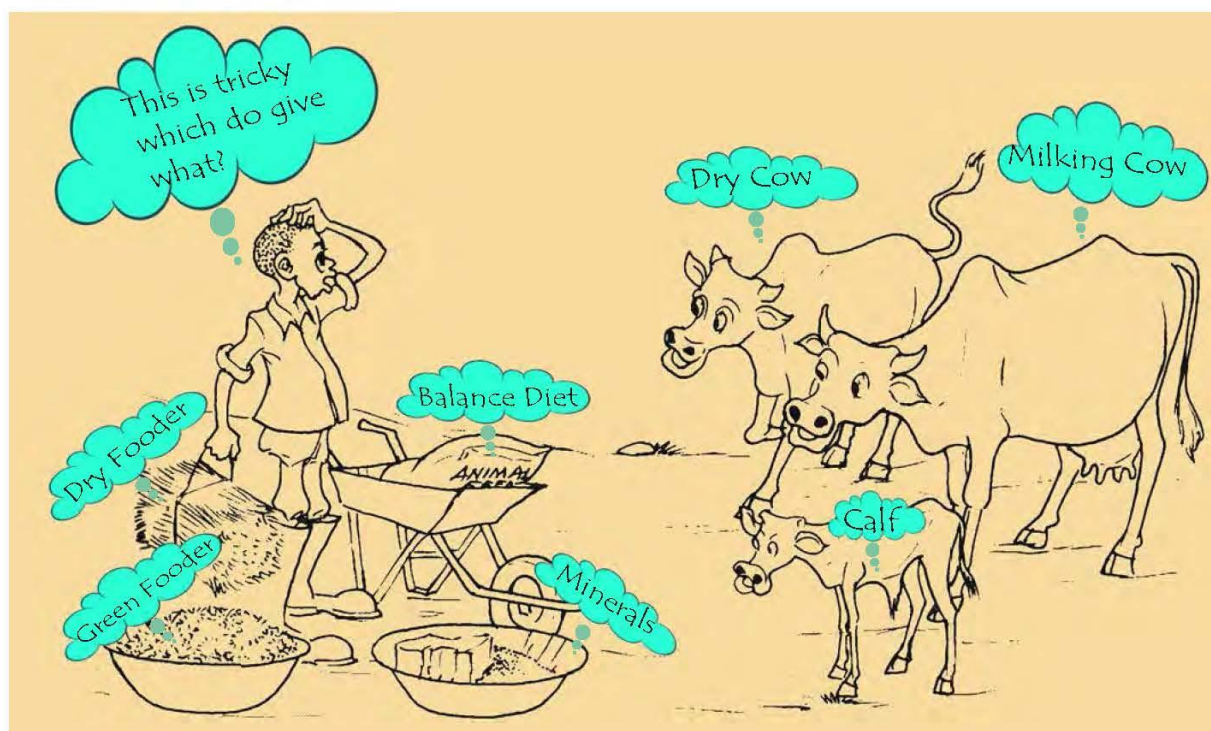
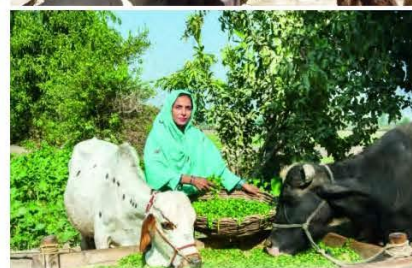
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Ration Formulation

1st

Step Obtain Required information

- **Body weight of cow**
- **Milk yield and fat percentage**
- **Stage of lactation and pregnancy**
- **Feeds available and their nutritive values**
- **Tables of nutrient requirements**



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Predicting Dry Matter Intake (DMI)

Thumb Rule # 01

A lactating cow will eat:

- 2.5 % of her live body weight if given low quality forage,









- 2.8-3.0 % of live body weight if given a medium quality diet,



- 3.0-3.3 % of live body weight if given a high quality diet.



Quality Of Ration For Milking Cattle & Buffaloes

					
Provides adequate amount of different, mixed nutrients from variety of sources	Is palatable and digestible	Has a good effect on health	Is bulky and includes sufficient green fodder	Includes preferably plenty of succulent green fodder	Is economical to feed

Remember.....

2 tea spoons of Salt should be added in ration and in addition to that Calcium + Phosphours should be also given.



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SINDH AGRICULTURE GROWTH PROJECT

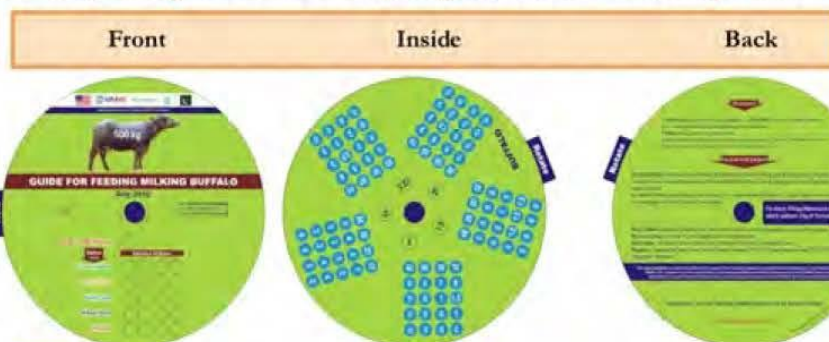
GUIDE TO USE 'FEED CHART' FOR MILKING CATTLE AND BUFFALOES

Introduction

AIP – Livestock is happy to introduce the 'Guide for Feeding Milking Animals' for use by small scale dairy farmers. Balanced ration is formulated based on level of milk production; 5, 7.5, 10, 12.5 and 15 liters per day for a milking animal of an average weight (Buffalo cow weighing 500 kg; cow weighing 350 kg). Separate guides are available for 'cattle' and buffaloes'.



For every 100 kg difference in body weight, add or subtract 3 kg of the roughage



Step 1: Hold with your left hand

Step 2: Turn 'Rotate' until you see the milk production of the buffalo cow or your desired level of production appears in the circle at the Centre of chart

10

Step 3: After selecting the desired level of milk production, the chart gives you 4 options from which you can select your ration based on green fodder availability and /or type of concentrate available.

Example: for 10 liters' milk

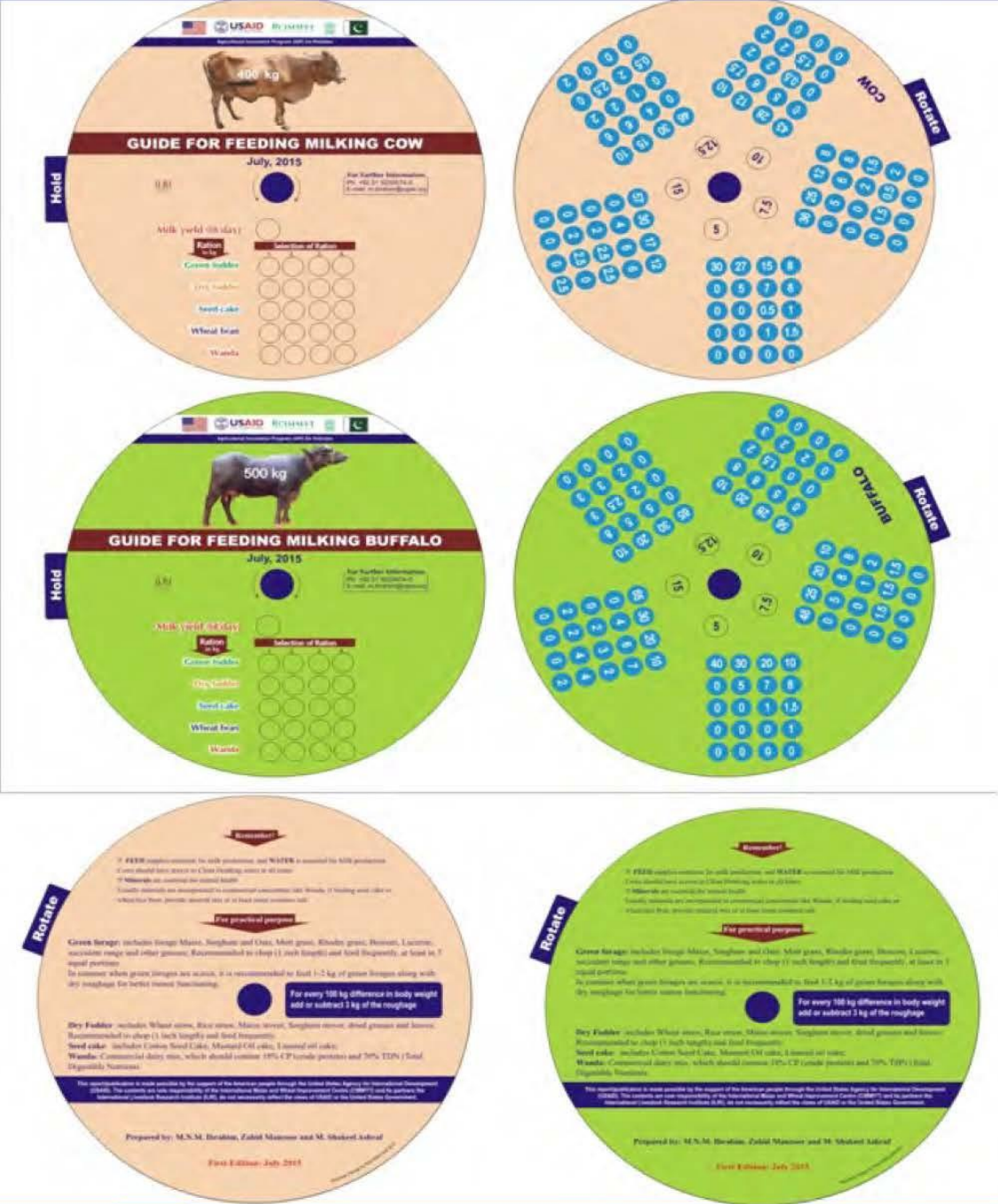
You will see 4 options as given below:



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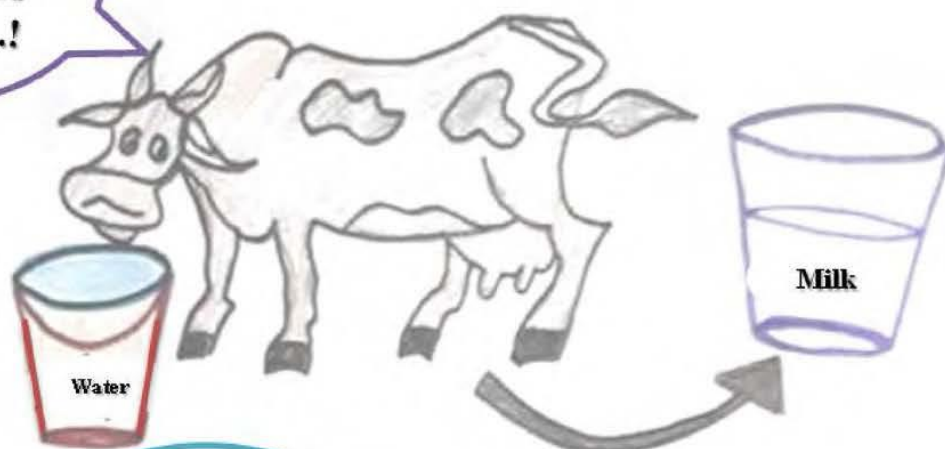
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SINDH AGRICULTURE GROWTH PROJECT



Ufff.....
Only two times
in a day

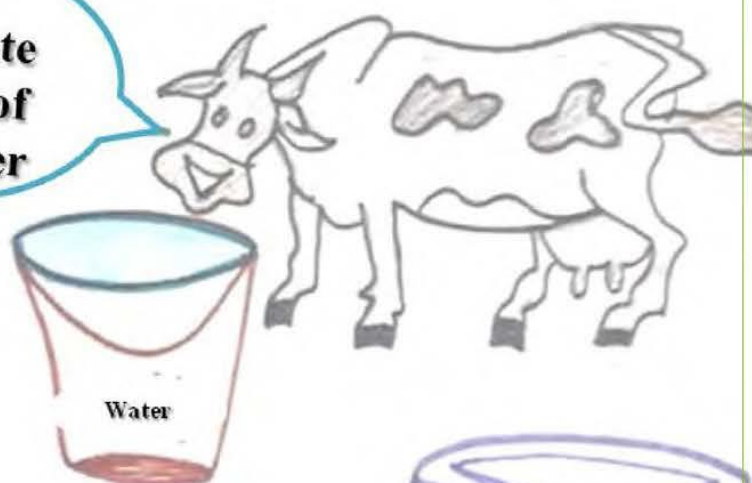
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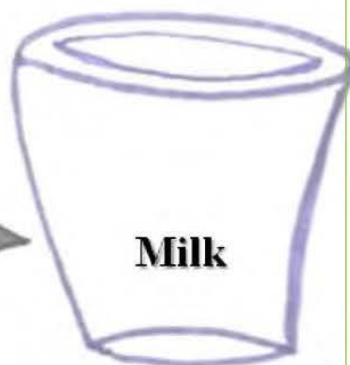
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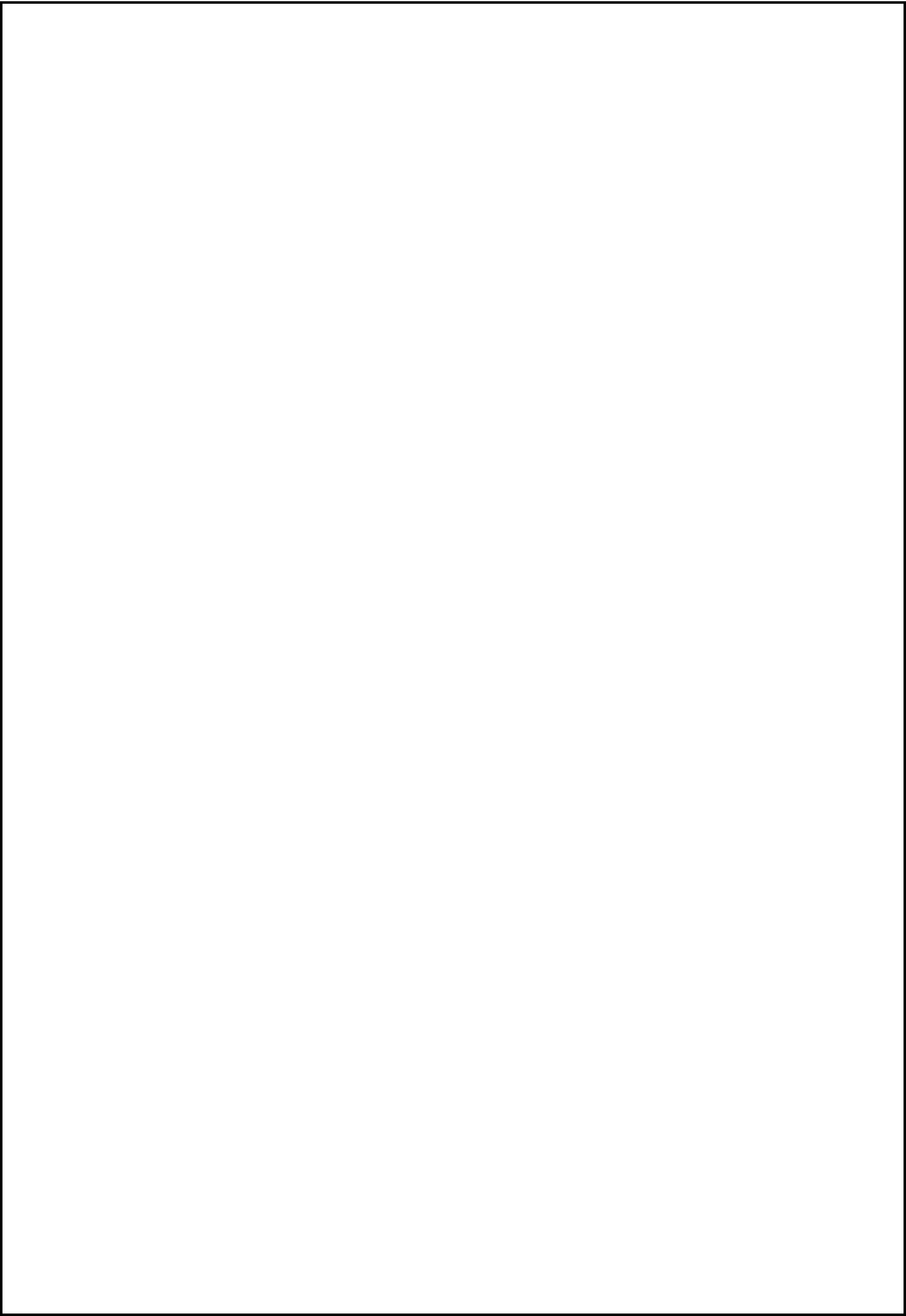
Adequate
supply of
the water

Adequate
supply of the
water
More Production
More Profit



3





Annex 4: Handouts on Ration Formulation

Handout 1: Basics of ration formulation

Handout 2: Feeding to Match Requirements

Handout 3: Using Excel spread sheet to match requirements

Handout 4: Using Computer/ANDROID Software for Ration Formulation

HANDOUT 1: BASICS OF RATION FORMULATION

Nutrient Requirement Tables

Nutrient requirements of cattle for maintenance, production and reproduction could be obtained from nutrient requirement tables (NRC, ARC, Kearn, ICAR etc.). The tables (compiled by Kearn for tropics are given in Appendix 2 and 3) provide information for varying body weights and production levels. These form the scientific basis for feeding of cows, however an in-depth knowledge in nutrition is needed to understand and make proper use of it. Field level extension agents need a less cumbersome, simple but reliable quick reference guide to work out the nutrient needs. With this aim, composite table which consolidates maintenance, growth, reproduction and pregnancy requirements for differential body weight, milk production and fat content were prepared for both an average cow (300 kg) and a buffalo cow (350 kg). Adjustments in nutrient requirements for differences in body weights of cow and buffalo cow are explained in the sections below.

The nutrient requirements for a growing, lactating cow weighing 300 kg is presented in Table 1 and for buffalo cow is presented in Table 2. These table could be used to find the nutrient requirements of cows of different body weights, milk production levels and with different milk fat contents.

Table 1

Daily nutrient requirements for a growing, pregnant, lactating cow weighing 300 kg (maintenance, growth, gestation and milk production)								
Milk Yield (Litres)	3.0 to 4.0 % Fat			4.1 to 5.0 % Fat			5.1 to 6.0 % Fat	
	TDN (g)	DCP (g)		TDN (g)	DCP (g)		TDN (g)	DCP (g)
1	4190	510		4240	520		4320	530
2	4480	560		4580	570		4740	580
3	4770	600		4920	610		5160	640
4	5060	640		5260	660		5580	690
5	5350	690		5600	710		6000	750
6	5640	730		5940	760		6420	800
7	5930	770		6280	810		6840	860
8	6220	810		6620	850		7260	910
9	6510	860		6960	900		7680	970
10	6800	900		7300	950		8100	1020
12	7380	990		7980	1050		8940	1130
14	7960	1070		8660	1140		9780	1240
16	8540	1160		9340	1240		10620	1350
18	9120	1240		10020	1330		11460	1460

Adjustment for different body weights:

For every **50 kg difference** in body weight, add or subtract **300 g TDN and 30 g DCP**.

Example on the use of Table 1:

How would you calculate the TDN and DCP requirements for a cow weighing 350 kg and producing 4 litres of milk with 4% fat?

	TDN (g)	DCP (g)
- 300 kg cow producing 4 litres milk with 6% fat	5060	640
- For 50 kg more bodyweight	+ 300	+30
Therefore, you have to feed	<u>5360</u>	<u>670</u>

Table 2

Daily nutrient requirements for a growing, pregnant, buffalo cow weighing 350 kg
(maintenance, growth, gestation and milk production)

Milk Yield (Litres)	4.0 % Fat			6.0 % Fat			8.0 % Fat	
	TDN (g)	DCP (g)		TDN (g)	DCP (g)		TDN (g)	DCP (g)
1	4710	565		4800	580		4900	600
2	5050	625		5230	655		5430	690
3	5390	685		5660	730		5960	780
4	5730	745		6090	805		6490	870
5	6070	805		6520	880		7020	960
6	6410	865		6950	955		7550	1050
7	6750	925		7380	1030		8080	1140
8	7090	985		7810	1105		8610	1230
9	7430	1045		8240	1180		9140	1320
10	7770	1105		8670	1255		9670	1410
12	7380	990		7980	1050		8940	1130
14	7960	1070		8660	1140		9780	1240
16	8540	1160		9340	1240		10620	1350
18	9120	1240		10020	1330		11460	1460

Buffaloes (Table 2):

Buffalo milk contains about 7 - 8 % fat, whereas cattle produce milk with about 3 - 4 % fat. Therefore, they require more TDN for every litre of milk produced.

As for cattle, for every 50 kg difference in body weight, add or subtract: **300 g TDN and 25 g DCP**

For EVERY 1% increase in fat content;

provide for EVERY LITRE of milk produced

50 g TDN and 8 g DCP EXTRA

HANDOUT 2: FEEDING TO MATCH REQUIREMENTS

Requirement of the animal for TDN and DCP depend on whether:

- ☞ The animal is **Idling** (maintenance requirement)
- ☞ **Growing** (growth requirement)
- ☞ **Pregnant**
- ☞ **Producing Milk**
- ☞ **Working** (pulling a cart/ploughing)

Therefore, in order to feed the animal according to its requirements you should know:

- **Nutrients Required** by the Animal
- **Nutrient Content** in Feeds
- **Amount** that can be **eaten**

The animal has a limited intake capacity. Therefore, all the TDN and DCP required by the animal must be included in a ration which does not exceed the intake capacity of the animal. The amount of feed an animal could eat depends on:

- Its **body weight** (*body weight can be estimated using the chest girth measurement and the table in the FACT SHEET below*)
- Type of **feed** (grass, legume, straw, concentrate...)
- **Quality** of feed (good, mature forages, treated.....)

You can get the nutritive values of all commonly available ruminant feeds in Pakistan from the booklet titled “Practical Guide for Feeding Ruminants in Pakistan” (Table 5), Published by Prof. M.N.M. Ibrahim. An extract from this book giving nutritive values of commonly available feeds in Pakistan are given below.

For practical purposes:

An animal will eat

- ✓ up to 2.9 kg/100 kg body weight of feeds above 55% TDN, and
- ✓ up to 2.5 kg/100 kg body weight of feeds below 55% TDN
- ✓ Also, a cow in early lactation could eat as much as 3.0 - 3.5 kg/100 kg body weight provided 2-3 kg of a good quality concentrate is fed together with roughage
- ✓ Also, dry matter intake of dairy animals increases with the increase in milk production.



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CIMMYT
International Maize and Wheat Improvement Center



Agricultural Innovation Program (AIP) for Pakistan

AIP Livestock Fact Sheet no: 13 (May 2015)

TAKING GIRTH MEASUREMENTS & ESTIMATING LIVE WEIGHT

جاتور کی جھاتی کی لمبیت اور جسمانی وزن کا تعین



Girth Measurement (cm) جھاتی کی پیمائش	Estimated live Weight (kg) جسمانی وزن
50	22
55	26
60	30
65	35
70	40
75	45
80	50
85	59
90	69
95	79
100	89
105	103
110	118
115	134
120	150
130	190

Girth Measurement (cm) جھاتی کی پیمائش	Estimated live weight (kg) جسمانی وزن
135	210
140	230
145	251
150	272
155	295
160	325
165	358
170	392
175	427
180	467
185	508
190	552
195	600
200	650
205	700
210	750

LRI
LIVESTOCK RESEARCH FOR
INNOVATION

This fact sheet is made possible by the support of the American people through the United States Agency for International Development (USAID). The contents are sole responsibility of the International Maize and Wheat Improvement Center (CIMMYT) and its partners, do not necessarily reflect the views of USAID or the United States Government.

Nutritive Value of some commonly available Feeds for Ruminants in Pakistan

	Feed	g DM	g TDN	g DCP	g Ca	g P
1	Mott grass	245	146	18	0.7	0.6
2	Oat Green fodder	172	150	16	0.0	0.6
3	Rhodes grass	250	143	11	0.7	12.4
4	Rhodes grass Hay	864	481	44	26.0	30.0
5	Natural Grasses	357	171	8	0.0	0.0
6	Sorghum fodder	334	188	12	0.0	0.0
7	Sorghum stover	870	470	11	0.2	0.2
8	Maize green fodder	210	144	13	0.0	0.0
9	Maize silage	320	216	11	2.0	0.0
10	Maize stover	876	467	13	2.2	1.0
11	Mustard forage	115	65	13	2.0	1.0
12	Oat forage	172	107	16	1.0	0.6
13	Berseem	158	203	11	0.0	0.0
14	Lucerne	182	132	31	5.0	7.0
15	Shaftal	129	71	11	2.0	1.0
16	Guar (Cluster bean)	217	182	31	2.0	1.0
17	Wheat straw	892	465	23	1.0	1.0
18	Rice straw	908	400	4	1.0	1.0
19	Wheat bran	903	750	81	3.6	1.0
20	Rice Bran	900	710	80	4.0	8.0
21	Concentrate (Wanda)	979	741	136	2.0	1.0
22	Cotton seed cake	924	556	150	2.0	1.0
23	Cotton seed meal	892	572	296	1.0	0.0
24	Urea Molasses Block (UMB)	835	738	185	0.0	0.0

DM=Dry Matter; TDN=Total Digestible Nutrients; DCP=Digestible Crude Protein

Ca=Calcium; P=Phosphorus

Using a calculator to match requirements and needs

Examples:

Feeding a 400 kg lactating cow for maintenance, growth, gestation and milk production.

Feeds available and their nutrient composition from Table 3:

Feeds	DM (g)	TDN (g)	DCP (g)	Ca (g)	P (g)
Mott grass	245	146	18	1.7	0.5
Lucerne (alfalfa)	287	195	43	4.0	1.0
Wheat bran	903	750	81	0.7	12.4

Example 1:

How to prepare a ration for the above cow to produce 5 litres milk per day with 4% fat?

Step 1:

Obtain the requirements for the animal from Table 1;

From Table 1:

	<u>TDN (g)</u>	<u>DCP (g)</u>
- 300 kg cow producing 5 l milk with 4 % fat	5350	690
- For 100 kg more weight (TDN=300x2; DCP 30x2)	<u>600</u>	<u>60</u>

Therefore you have to feed

5950 750

Step 2:

 Remember forages are cheap, so first check whether you can satisfy the nutrient requirements with forages!!

First check whether you can satisfy the above requirements using Mott grass alone.

Amount of Mott grass to be fed:

146 g of TDN is present in 1 kg of fresh Mott grass

Therefore, to obtain 5950 g TDN we need = $5950/146 = 40.8$ kg fresh grass

$$\frac{\text{TDN requirement}}{\text{TDN content in feed}} = \frac{5950}{146} = 40.8 \text{ kg}$$

The amount of DCP supplied by feeding 40.8 kg fresh Mott grass is: $40.8 \times 18 = 750$ g which is the DCP requirement of the animal to produce 5 l milk (750 g).

Note:

- The cow's dry matter intake (DMI) capacity is **12 kg DM** ($400 \times 3/100$); The DMI from Mott grass is only **10 kg DM** ($40.8 \times 245 = 9.99$).
- The cow gets sufficient quantity of Ca and P, and Ca:P ratio is close to 2:1.
- Also, remember to feed about 2 tablespoons of salt with the ration.

Example 2:

How to prepare a ration for the above cow to produce 10 litres milk per day with 4% fat?

Step 1:

Obtain the requirements for the animal from Table 2;

From Table 2:

	<u>TDN (g)</u>	<u>DCP (g)</u>
- 300 kg cow producing 10 l milk with 4 % fat	6800	900
- For 100 kg more weight (TDN=300x2; DCP=30x2)	<u>600</u>	<u>60</u>
Therefore you have to feed	<u>7400</u>	<u>960</u>

Feeds	DM intake (kg)	Fresh weight (kg)	TDN (g)	DCP (g)	Ca (g)	P (g)
Option 1: If farmer has enough Lucerne						
Mott grass	10.0	40	5840	720	68	23.2
Lucerne (alfalfa)	1.7	8	1560	344	32	8.0
Total	11.8		7400	1064	100	31.2
Option 2: If farmer has limited Lucerne, then use also Wheat bran						
Mott grass	9.1	37	5402	666	62.9	21.5
Lucerne (alfalfa)	1.3	4.5	878	194	18.0	4.5
Wheat bran	1.4	1.5	1125	122	1.1	18.5
Total	11.7		7405	981	82.0	44.5
Option 3: If farmer has limited Mott grass and Lucerne, then balance with Wheat bran						
Mott grass	7.6	31	4526	558	52.7	18.0
Lucerne (alfalfa)	1.0	3.5	683	151	14.0	3.5
Wheat bran	2.7	3.0	2250	243	2.2	37.1
Total	11.3		7459	952	68.9	58.6

Note:

- In all 3 options the cow gets sufficient quantity of Ca and P, and Ca:P ratio is 3:1 in *option 1*, 1.8:1 in *option 2*, and 1.2:1 in *option 3*, so there should be no problem.
- Also, remember to feed about **2 table spoons of common salt** with the ration.

A simple rule of thumb is: 1 extra kg of a good commercial dairy meal (above 700 g TDN) fed above maintenance requirement should give at least an additional 2.0 litres of milk

**Another practical guideline for early lactation (first 12 weeks) is:
Give 0.5 kg of dairy meal for every litre of milk above 5 litres per day**

**So, if a cow is giving 10 litres of milk per day it should be fed:
 $10 - 5 = 5 \times 0.5 \text{ kg} = 2.5 \text{ kg dairy meal per day.}$**

HANDOUT 3: USING EXCEL SPREAD SHEET TO MATCH REQUIREMENTS

By the end of this training you will:

- *Be competent in using an excel spread sheet soft program to balance nutrients available in various feedstuffs available locally, and predict the amount of milk production achievable*

The excel spread sheet program described below was prepared to suit the feeding conditions in Pakistan.

Once you are familiar with the basics of formulating a ration doing the hard way manually using a calculator, the excel spread program is a reward you receive to assist the dairy farmers in your area with better and appropriate feeding options.

The spread sheet as it appears when you open it in Microsoft Excel is shown in the adjoining page. Step-by-step instructions are given below in how to enter data!!



Step 1: ENTER the body weight of the cow in kg in cell A2

The following changes will automatically take place:

- Cell A4, will tell you the Dry Matter Intake (DMI) Capacity of your cow;
- Cell E4, F4, G4 and H4 will tell you the TDN, DCP, Calcium and Phosphorus requirement of your cow Maintenance, Growth and Gestation;

Note: The DMI is based on 3% bodyweight of the cow. However when mature grasses or straw/stover are fed as the main basal roughage, the intake will be lower (25-2.8% bodyweight)

Step 2: ENTER the Fat content (in %) in your cows' milk in cell A6

- Cell E6, will change indicating the amount of TDN needed to produce 1 kg of milk;

Step 3: ENTER the DCP content (in %) in your cows' milk in cell A7

- Cell F6, will change indicating the amount of DCP needed to produce 1 kg of milk;

Note: If you do not know the Protein content, do not make any entry in Cell A7

Step 4: Select the feeds you want to include in your cows ration, you can select up to 20 feeds. Choose roughages (grass/legume/tree fodders etc) available in the area, 1 or 2 concentrates, and a mineral mixture!!

Step 5: ENTER the name of the feed 1 you want to include in the ration in cell B11, and its DM, TDN, DCP, Ca and P in cells D10, E10, F10, G10, H10, respectively.

These values are in g per kg fresh weight and can be obtained from *Table 5 of your Practical Guide for Feeding booklet*. If you know the price of the feed, enter the cost in Rs/kg in cell I 10.

Depending on the number of feeds you have chosen, continue entering the name of the second feed in B13, and its DM, TDN, DCP, Ca and P in cells D12, E12, F12, G12, H12, respectively, and its price in I 12;

Step 6: ENTER the amount in kg fresh weight you want to include in the ration in cell C11.

The following changes will automatically take place:

- Cells D11 to H11 will change indicating the amounts of nutrients contributed by the said quantity of feed included. Also, I 11 will show the cost of the feed;
- Cell A5 will tell you the amount of Total DM the cow has consumed;
- Cell C3 will tell you the amount of Total Fresh feed the cow has consumed;
- Cells E3, F3, G3 and H3 will tell you the amount of TDN, DCP, Ca and P contributed by the amount of feed to have included;
- Cells E5 to H5 will indicate the amount of nutrients available for milk production;

- Cell **E7** and **F7** will tell you the amount of milk that can be produced from the nutrients you have supplied via the feed (take the average to assess production);
- Cell **G8** will indicate to you the amount of DM the cow can still consume;

Continue entering the other feeds you have chosen and observe the changes taking place!!

Cell **I 6** will give the cost of your ration, and Cell **I 8** will indicate the cost per kg milk.

	A	B	C	D	E	F	G	H	I
1	Ration calculation Guide (Excel spread sheet prepared by M.N.M. Ibrahim)								
2	A2	Kg weight of cow	kg Fresh Wt.	g Dry Matter	g TDN	g DCP	g Ca	g P	COST
3	Total nutrients in this ration		C3		E3	F3	G3	H3	Cost of Ration I 6 Cost per kg Milk I 8
4	A4	DM intake Capacity (kg)	Maintenance, growth & gestation		E4	F4	G4	H4	
5	A5	Total DMI from Ration (kg)	Nutrients available for milk		E5	F5	G5	H5	
6	A6	Fat content in milk (%)	Nutrients needed for 1 kg milk		E6	F6	2.7	2.0	
7	A7	Protein content in milk (%)	Kg milk from RATION		E7	F7			
8		Cow has eaten	C8	kg DM	She can still eat		G8	kg DM	I 8
9	Enter the fresh weight of the feeds you want to include in the cow's ration in the shaded cells below (cell 'C')				DM, TDN, DCP, Ca, P data (all in grams) for pinkish cells you obtain from Table 5 of the Practical guide booklet and enter				
10				D10	E10	F10	G10	H10	I 10
11	1	Feed 1 (B11)	C11	D11	E11	F11	G11	H11	I 11
12				D12	E12	F12	G12	H12	I 12
13	2	Feed 2 (B13)	C13	D13	E13	F13	G13	H13	I 13
14				D14	E14	F14	G14	H14	I 14
15	3	Feed 3 (B15)	C15	D15	E15	F15	G15	H15	I 15
16				0	0	0	0.0	0.0	
17	4	Feed 3 (B17)	0.0	0.0	0	0	0.0	0.0	0.00
18				0	0	0	0.0	0.0	
19	5	Feed 3 (B19)	0.0	0.0	0	0	0.0	0.0	0.00
20				0	0	0	0.0	0.0	
21	6	Feed 3 (B21)	0.0	0.0	0	0	0.0	0.0	0.00
22				68	53	0	0.0	0.0	
23	7	Feed 3 (B23)	0.0	0.0	0	0	0.0	0.0	0.00
24				0	0	0	0.0	0.0	
25	8	Feed 3 (B25)	0.0	0.0	0	0	0.0	0.0	0.00
26				0	0	0	0.0	0.0	
27	9	Feed 3 (B27)	0.0	0.0	0	0	0.0	0.0	0.00
28				0	0	0	0.0	0.0	
29	10	Feed 3 (B29)	0.0	0.0	0	0	0.0	0.0	0.00
30				0	0	0	0.0	0.0	
31	11	Feed 3 (B31)	0.0	0.0	0	0	0.0	0.0	0.00
32				0	0	0	0.0	0.0	
33	12	Feed 3 (B33)	0.0	0.0	0	0	0.0	0.0	0.00
34				0	0	0	0.0	0.0	
35	13	Feed 3 (B35)	0.0	0.0	0	0	0.0	0.0	0.00
36				0	0	0	0.0	0.0	
37	14	Feed 3 (B37)	0.0	0.0	0	0	0.0	0.0	0.00
38				0	0	0	0.0	0.0	
39	15	Feed 3 (B39)	0.0	0.0	0	0	0.0	0.0	0.00
40				0	0	0	0.0	0.0	
41	16	Feed 3 (B41)	0.0	0.0	0	0	0.0	0.0	0.00
42				0	0	0	0.0	0.0	
43	17	Feed 3 (B43)	0.0	0.0	0	0	0.0	0.0	0.00
44				0	0	0	0.0	0.0	
45	18	Feed 3 (B45)	0.0	0.0	0	0	0.0	0.0	0.00
46				0	0	0	0.0	0.0	
47	19	Minerals (B47)	0.0	0.0	0	0	0.0	0.0	0.00
48				0	0	0	0.0	0.0	
49	20	Minerals	0.0	0.0	0	0	0.0	0.0	0.00

g DM = Dry matter in the fresh feedstuff;

g DCP = Digestible Crude Protein contents in the fresh feedstuffs;

g TDN = Total Digestible Nutrient contents in the fresh feedstuffs;

g Ca = Calcium in gram; g P = Phosphate in gram;

HANDOUT 4: USING COMPUTER/ANDROID SOFTWARE FOR RATION FORMULATION

When you open the software, the screen below appears.

STEP 1: Language Choice

STEP 2: Species Choice

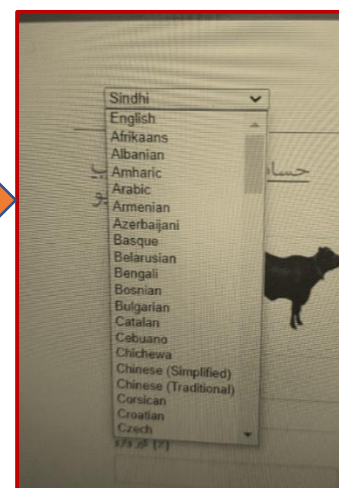
STEP 3: Body Weight in Kg

STEP 4: Fat content in Milk (%)

STEP 5: Feed Choices

STEP 1:

When you click on the **language box**, drop down menu with the languages will appear, from which you can select the language of your choice (for Pakistan, English, Urdu and Sindhi options are available)





STEP 2: Click on the animal of your choice (Cattle or Buffalo)



STEP 3: Enter body weight of animal in kg





STEP 4: Enter Fat content in Milk in %



English

Calculate Ration



Body Weight (kg)



Milk Fat (%)



STEP 5: By clicking a particular FEED (in this case I have clicked on Mott grass) the background colour of the feed turns light blue indicating that you have shown this feed. Also 2 other boxes appear below the fat content box; (1) fill in the quantity of the feed in kg (2) if you know the price of the feed, enter in PKR.

English

Calculate Ration




Body Weight (kg)

Milk Fat (%)


Quantity

Cost per Kg


Feed



Mott Grass



Maize Stover



Berseem

Select FEED

Enter quantity of FEED in kg

Enter price of FEED in PKR



STEP 6: By pressing **RESULTS**, you can see the feeds selected and the milk production you can get



STEP 7: By pressing **PRINT**, you can also get a printout of the ration details

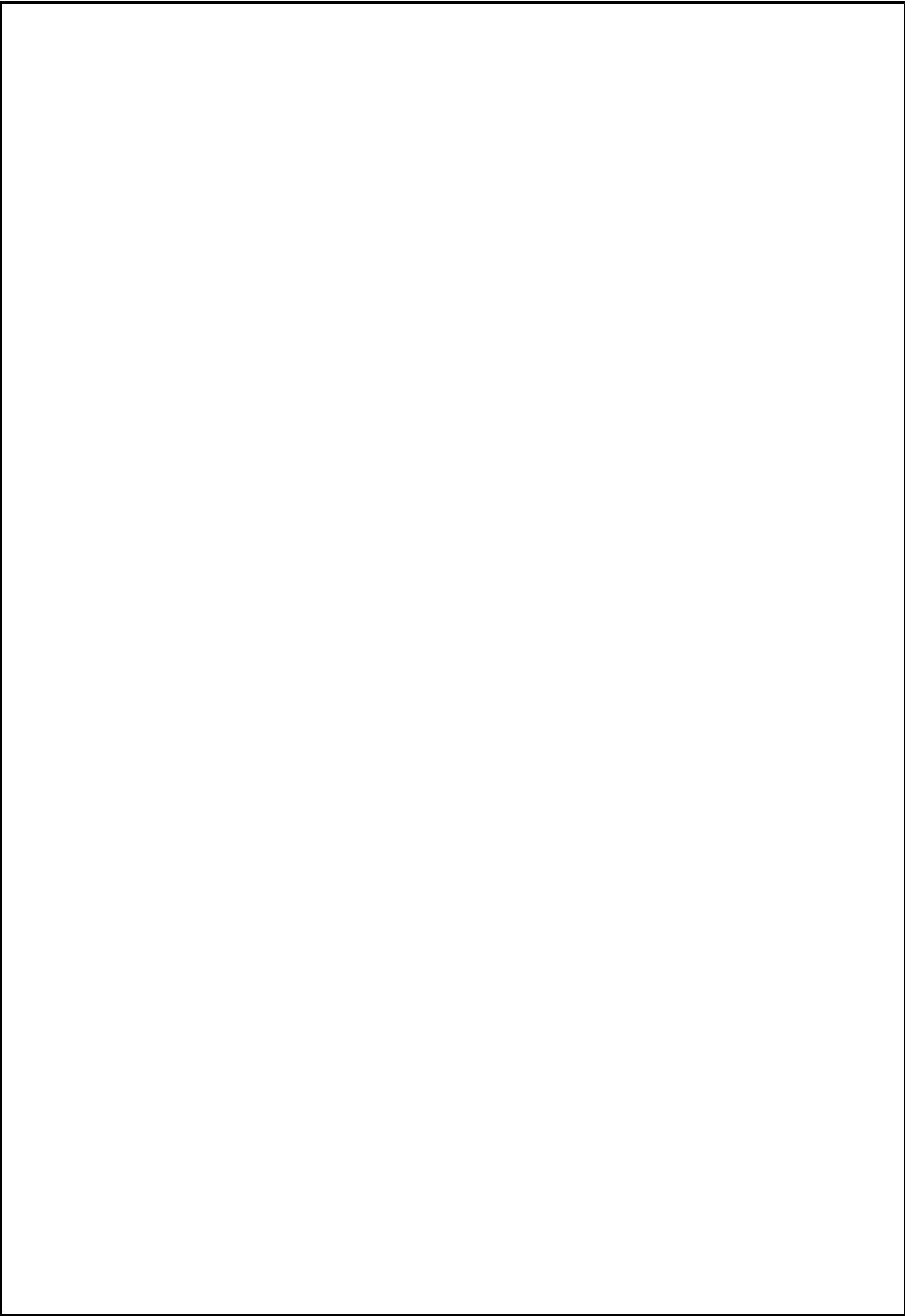
Basic Info		
Species	cattle	
Body Weight (kg)	350	
Fat Content (%)	3.8	

Selected Feeds		
S.No	Feeds offered	Quantity
1	Mott Grass	35
2	Rice Bran	3

Results	
Dry matter capacity (kg)	10.5
Dry matter intake (kg)	11.275
Difference in DMI (kg)	-0.775
Milk Production (L) based on limiting nutrient (DCP/TDN)	9.93
Cost of ration	0

Comments:

- Note that the animal intake capacity is 10.5 kg, and you are offering 11.3 kg (that is 0.8 kg more than the animal could eat), therefore you will have to reduce the amount of feed offered. This will also change the amount of milk produced!!
- If the limiting nutrient is DCP, you can get more milk by adding a protein source like Cotton Seed Cake or Soya meal or legume
- If the limiting nutrient is TDN, you can get more milk by adding energy source like wheat or rice bran or good quality grass



Feeds and Feeding

1. Which are ruminant animals enlist those animals? Why do ruminants do regurgitation?

- Animals are : Sheep, Goat, Buffalo, Cattle and Camel
- Ruminant animals do regurgitation in order to digest feed properly

2. Name the part of ruminant animal in which rumination / digestion (factory) occurs?

- Rumen

3. What are the types of feeds you know?

- Green feeds: grasses, maize & sorghum fodders, Legumes
- Dry feeds: wheat straw, rice straw, hay
- Concentrates: wheat/rice bran, cotton seed cake, crushed rice/wheat, Wanda

4. Name some legumes; difference between grasses and legumes

- Berseem, Lucerne
- Legumes are high in protein

5. What factors determines milk production

- Weight of animal
- Stage of lactation
- Type, quantity and quality of feeds eaten
- Amount and frequency of water offered

6. What is balanced feeding and for what nutrients you balance for?

- Feeding nutrients for the desired level of production (maintenance, reproduction, growth and milk production)
- Major nutrients needed are Energy/Protein
- If the feed is not balanced what happens?
- Production will be low/limited by the types of nutrients it is fed

7. Water

- Importance of water?
- 75% of animals body is water
- Needed for all metabolic processes including saliva production and milk production
- Any idea of the amount of water needed by a dairy animal?
- 10% body weight + 1.5 litres for each liter of milk produced
- How much of water is there in milk?
- More than 85% of milk is water

8. Why are minerals important for dairy animals?

- Needed for animals to REMAIN HEALTHY and for proper body functions, development of bones, reproduction and milk production
- High milk producing animals need more Calcium and Phosphorus

9. Can you explain how the feeding chart works?

- Get few of the farmers to demonstrate the feeding chart how to use it
- Why do we have separate feeding charts for Cattle and buffaloes
- Buffaloes are heavier, and milk has more fat

ISBN: 978-969-7564-11-8

**Citation: M.N.M. Ibrahim, E. Kang'the, S.A. Khan and J.Githinji, 2020.
Training Facilitator guide on Feeds and Feeding. pp. 83.**